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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

MAY-OCTOBER.
North-East Coast Exhibition at Newcastle-on-Tyne.

JULY 16-27.
International Aero Exhibition at Olympia, London, W.

The Technical Side of Our Industry.

We have already referred in these columns to the fact that our recent foreign visitors, and our American visitors in particular, were so keenly impressed by the technical exhibit at the Foundry Exhibition. It would, therefore, appear to be only reasonable to devote some further time and space to the consideration of this exhibit and its significance to our industry. No one will venture to dispute the statement that it represented a vast advance upon any previous effort in this direction, and we are tempted to the reflection that if so much progress can be achieved in three years, there is every reason to anticipate great things in the future.

The exhibit was made possible by the co-operation of the Research Associations, the National Physical Laboratory, the Universities and other research laboratories, and by the voluntary work of a committee whose efforts deserve the warmest appreciation and congratulation. Its scope was considerable, covering melting practice, moulding sands, casting process, special cast materials, after-treatment of metals, and test research and laboratory methods and appliances. The most general interest was undoubtedly aroused by the section of the exhibit dealing with coal-dust and sand testing, and it is evident that the foundry world is ripe for a forward step here. The feeling was expressed that the average foundry uses more new sand than should be necessary if proper control were exercised, and it was recognised that adequate testing in this direction is of great assistance in the diminution of costs.

Keen interest was also shown in the portable X-ray outfit, and, while appreciating the difficulties involved, many visitors regretted that the demonstrations were not more frequent. The full significance of the technical exhibit will be the better appreciated when we point out that it succeeded in impressing both the practical and the technical man. The industry is a practical affair run by practical men, but it is well aware of the vital assistance that it can obtain from the technical men. It is positively nauseating to hear cast iron described repeatedly as the Cinderella of the metallurgical world, and it is gratifying to find an indication in the attention paid to this exhibit by the scientific men that the appellation is no longer justified. It may not be inapposite to add a note on the Foundry Education Exhibit. It served the useful purpose of focussing attention upon the available specialised courses for founders, whether on the craft or the scientific side. Furthermore, it emphasised rather than denied the need for an educational scheme that shall apply to the country as a whole, giving us as a result foundrymen as competent as those trained, for example, by some of the Continental schools. Altogether those responsible for the non-commercial sections of the Exhibition may feel well satisfied with the outcome of their work.

Co-operation as an International Publicity Medium.

There has recently been a revival of interest in the history of engineering and metallurgy, and one particular phase will be of real value if it can only be extended. We refer to a Paper read by Mr. R. W. Bailey before a recent meeting of the Institute of Mechanical Engineers on "The Contribution of Manchester Researches to Mechanical Science." If this could be done systematically to cover all other centres a reasonably complete story would be available. Students learning the principles of engineering or metallurgy, whether they be located in Barcelona or Tokio, encounter the names of Watt, Stephenson, Boulton, Fairbairn, Nasmyth and all those other pioneers of the industry. Thus there can be no doubt as to the value of the publicity which this type of Paper gives to Great Britain.

A matter to be stressed is that there exists in districts a continuity of related enterprise and subject-matter, exactly comparable with the various schools of art. We are aware that various societies exist for the study of the history of engineering and science generally, but their effort is something akin to "preaching to the converted." But the Proceedings of the Institute of Mechanical Engineers is handled by "hard-headed" industrialists and professors dispersed throughout the world. Herein lies the real publicity value of such work.

It is not realised by the units of the foundry industry that the support they accord to their technical and research associations reacts very favourably in foreign markets. It gives to the overseas buyer a sense of confidence that British industry is alive, erudite yet studious, conscious of its past achievements yet progressive, patriotic yet still sufficiently broadminded to welcome, where possible, foreign adhesions. It should be borne in mind that whatever the defects existing in British foundry technical organisations, they are the concrete expression of our scientific and practical enterprises. This feature—the international publicity value of co-operative technical and research effort—is so important that it overshadows any other aspect and renders any possible transient defects unworthy of anything other than a helpful constructive criticism.

Finally, well-timed and well-organised international conferences, such as has recently been held in Great Britain, represent the best form of publicity for our industry as a whole, and the individual unit benefits by inference.

The foundry industry in Great Britain is organised through a number of broadly-based elastic nuclei, but expansion is an essential, especially amongst the employers' federations. To those who, like ourselves, have for many years made serious efforts to effect co-operation, we ask them to continue their work, and stress the international publicity-value of such enterprises as a cardinal point.

XUM

Wet Cleaning Shops.

By Dr. Ing. Max Maier.

The idea of the wet cleaning of castings is an old one, and wet cleaning plant has actually been tried both in Germany and in America. In relation to the importance of the subject, however, very little is to be found in the literature, and that little deals mainly with the results of experimental work, which are not so encouraging as to have been likely to lead to the general adoption of such methods—quite apart from the appreciable first cost involved.

Writing in "Die Giesserei," Dr. Maier describes a wet cleaning shop which is functioning with marked technical and economic success at the Esslingen works of his firm, Messrs. Fritz Müller, who are manufacturers of hydraulic presses and similar plant.

The author emphasises at the outset that it is obviously useless to think of constructing a wet shop unless it is certain that the latter is going to be a paying proposition. Although, therefore, his firm had over fifty years' experience as hydraulic engineers behind them, it was not until two years had been spent in systematic experimental and development work that the plant which is now doing such good service was decided upon. The tests showed that, for the existing needs, the ideal conditions were a working pressure of 50 atmospheres (735 lbs. per sq. in.) with a nozzle opening of 5 to 6 mm. in diameter. Not until it was indisputably proved that successful results were thus ensured was the construction of the actual plant undertaken.

Details of the Equipment.

The room itself is 14 ft. 9 in. by 13 ft. in area and 13 ft. high, and is open on top. The floor is composed of removable gratings, through which sand and water can fall into the first settling basin, 1 metre deep. Three other settling basins are connected "in series" with the first, but serve only to clear the water thoroughly of any sand, etc., carried over from the first basin, so that the water can be freely run down the drain. The sand from Basin 1 is dried and stored until, after some weeks, it is again used, together with suitable admixture of new sand. The very fine particles, which render the cleaning sand so dangerous on re-use, are carried off in colloidal form by the water.

Only 2.5 litres (0.55 gall.) of water per second are required at a pressure of 735 lbs. per sq. in. and with a nozzle diameter of 5 to 6 mm. On account of this extremely low water consumption it is not necessary to make use of the water over again, and it can be run to waste—a great saving, no doubt, in pump wear.

In place of a roof, a rotating device is fixed up over the cleaning shop, to which is attached a hose, so that by simply pulling on the latter the operator can move it with him more or less vertically around the casting to be dealt with. In this way, the easy manipulation of the nozzle is assured. It is possible for the operator to approach as close to the object as desired and to direct the jet, using both straight and curved nozzles, into the most difficultly accessible places, thus getting rid of practically the whole of the cores. It is just this manœuvring ability on the part of the operator which means such an inestimable advantage from the points of view of output and water consumption in comparison with more ambitious plants where disproportionately large volumes of water are employed and correspondingly high counter-pressures met with. More particularly is this so, as wet cleaning aims, in the main, at the removal of cores—in contradistinction to the sand blast, with which only the surface can be cleaned. In this case, the jet must be brought up as close as possible to the core opening and, during the further course of the cleaning operation, introduced into the hollow parts of the casting—if necessary, employing a curved nozzle. The shorter the jet, the greater the boring effect.

Results Obtained.

The appearance of the castings dealt with in this plant is beautifully clean, with only a very slight deposit of rust. A bluish appearance is noticeable, the intensity of which becomes greater the hotter are the castings when subjected to the jet. Any sand which may now and then still be unremoved from deep corners and crevices is at least loosened and can be got rid of without trouble. The operator wears porous linen clothing and is provided with an overall of waterproof rubber cloth, an elaborate waterproof helmet affair and rubber boots.

The plant can deal comfortably with a monthly output of 300 tons. In a table the author gives working data obtained in the manufacture of parts (weighing from 5 cwts. to 2½ tons each) for hydraulic presses. The cores are made, some of loam and some of sand, no difference in speed of removal of the two kinds being noticeable. The most important and striking feature of the table is the extraordinarily accelerated speed of cleaning when the wet method is used as compared with the usual means. On an average, it is found that the wet method is 6½ times faster. Hence the perhaps six men employed in a cleaning shop can be reduced to one, with a saving of five men's wages. The author gives figures to show that, under German conditions, a net economy of RM. 9,000 is achieved per annum, the plant thus practically paying for itself in the first year.

Finally, great advantage is claimed to lie in the total elimination of dust clouds, the operator being able to work far more quickly and comfortably and with far less risk of injury to health than when swallowing clouds of dust.

Falkirk Holidays.

The annual holiday "trek" began from Falkirk on June 28, when thousands left the foundry town for coast and country. The iron foundries closed down in the evening, and in the majority of cases resumption has been fixed for Tuesday, July 9. The period leading up to the holidays has been one of continued depression in the builders' castings industry, although during the last month or two there has been a very slight and encouraging improvement in trading conditions. The light castings industry in Falkirk continues to be severely hit by outside competition, not only from the Continent of Europe, but also from the Dominions. The effect of the big merger by which a number of the principal Falkirk ironfounding firms were recently amalgamated with others in the Midlands and South of England has yet to be felt.

Fatigue in Industry.

The Industrial Fatigue Board, which was set up by the Government 11 years ago for the scientific study of conditions in industry, and with a view to establishing conditions favourable to the health of the workers, are at present carrying on investigations in Glasgow. An appeal signed by Mr. Arthur Pugh, general secretary of the Iron and Steel Trades Confederation, who is a member of the Board, asking trade unions and members to give any help that may be needed, has had a good response. Workers engaged in the engineering and allied trades have been receiving the attention of the investigators, and their response to the request to submit to a few tests, such as height, weight, strength of grip, strength of lift and pull, etc., has been very satisfactory. Employers are giving the board every assistance by giving facilities and accommodation within their establishments and allowing their employees to undergo the tests during working hours without loss of wages.

Random Shots.

I hear on the very best authority that "Ramdom Shots" now enjoy a considerable international public. I was told the other day by one of our regular readers that during a recent visit to the Continent he was somewhat surprised when his host's wife, after asking him to explain what was meant by the terms "flapper" and "the flapper vote," produced as her reason a cutting from this column containing the flapper limerick that I gave you some weeks ago! Such indeed is fame!

* * *

But, as a matter of fact, the implication contained in the above paragraph is not strictly truthful. I was made aware a long time ago—rather painfully aware, as a matter of fact—that my readers are not by any means all located in this country. When the Spanish Foundry Convention was first being discussed, about eighteen months ago, I hazarded the guess—not altogether disproved by the event, as it happened—that the English delegation would not be very large. I added that this might be explained in various ways, and suggested that very few people knew the language, that Spain seems so very much farther away than France or Germany (which it is, after all), and that the reputation of the railways was not of the best. This last statement, I now freely confess, was founded in no way upon ascertained facts, but merely upon a rather vague impression of my own that was subsequently proved to be entirely erroneous. I still recall the avalanche of indignant letters that descended upon the head of my unfortunate friend the editor, pointing out that the Spanish railway system was second to none in the world, that the fares were low, the accommodation excellent, the punctuality perfect, and enclosing leaflets, guide-books and time-tables to reinforce the argument. "Marksman" duly admitted that it had been one of the rare occasions when he really didn't know what he was talking about, and he registered a solemn vow that in future he would verify his every statement. . . .

* * *

At the time, indeed, I somewhat took the affair to heart, and reflected how hard is the lot of the would-be humorist. But I was a good deal cheered the other day to find that mistakes over railway matters are actually in the best literary tradition. For I came across a selection of such mistakes made by the great ones of our country, and here are some of them. Mr. Arnold Bennett, in his latest novel, sends his hero from Paris in a steam train over a line that is electrically operated. Mr. Kipling, a long time ago, embarked a couple at Waterloo on the Southern Railway and discovered them next morning on the Great Western. Sir Arthur Conan Doyle once started his famous Sherlock Holmes off at Charing Cross for the Continent and disembarked him at Canterbury before the connecting Chislehurst loop-line was built, *i.e.*, he was miraculously transferred en route from the old Chatham line to the South Eastern! While Mr. Cutcliffe-Hyne once allowed Captain Kettle, on his way from Liverpool to the Tyne, to land up at Penrith!

* * *

I met Albert the other day, and he told me in the course of conversation that a man doesn't have to be a skilled musician to be able to blow his own trumpet, and a soloist on the trumpet isn't necessarily a skilled musician. . . .

Marksman.

Public Library
Preston Hall

The Technical Exhibit.

The Technical Exhibit at the International Foundry Trades Exhibition was arranged as a collective scientific and technical exhibit illustrating some of the scientific and research work which is being carried out in the interests of the foundry trade. To this end a number of research organisations and laboratories contributed exhibits, and the resulting collection was warmly praised by all who saw it. A close study of the whole of the technical exhibit took more time than the average visitor to the Exhibition could afford, but the material was classified and grouped in order that materials of a similar nature should be in close proximity.

Melting Practice.

It is proposed here to deal with the various exhibits in the order in which they were arranged. The first section was *melting practice*. An interesting series of cupola cokes were exhibited, the varying texture of the cokes from the different districts being well shown by means of photographs and sections cut through the lumps (both transversely and longitudinally) and embedded in plaster and polished similar to metal macrostructures. The " shatter " test for testing the hardness of the cokes and the combustibility test for determining efficiency of the cokes were illustrated, and the results of these tests on typical cokes were given. It is interesting to note that these tests place the cokes in the same order of efficiency as do practical large-scale melting-tests in a 5-ft. cupola, namely, Welsh, Durham, Yorkshire and Lancashire.

The coke exhibits were supplied by the recently-formed Midland and Northern Coke Research Committees.

The application of high-frequency electric furnaces to steel melting, brass melting, and more recently to alloy cast-iron melting, has received considerable attention of late, and it is interesting to note that a laboratory-size H.F. Ajax-Northrup furnace was shown, together with photographs of larger installations in steel foundries. Photographs of other electric melting plant for steel and brass were exhibited. The utility of the high-frequency furnace was indicated by a spray of small cobalt steel castings for magnetic signs which were cast from one of these furnaces.

There was also a series of photographs showing the inner structure of refractory materials such as sillimanite and mullite. These were from Mr. W. J. Rees, of Sheffield University. Some cupola lining and patching materials were shown by the B.C.I.R.A.

Moulding Sands.

A very complete series of tests on moulding sands is shown by the British Cast Iron Research Association. These tests include practical foundry tests and laboratory tests. The former have been specially developed on simple lines and consist of a *compression test* and a *permeability test*. The compression test comprises a means of applying a load up to 28 lbs. and a means of measuring the applied load. The test-pieces of green sand are rammed up in a small core-box $1\frac{1}{2}$ in. dia. and $2\frac{1}{4}$ in. deep, and the cores are broken in the machine. The cores may be weighed before testing to obtain the degree of ramming for the particular test-piece. The permeability test is carried out by passing ordinary town's gas through a core of sand about 3 in. dia. and 8 in. deep in a brass container. The gas, on reaching the top of the sand core, is ignited by a pilot jet. The time taken for the gas to pass through the sand is recorded as the permeability value. These two tests form admirable works control tests, and the apparatus can be purchased quite cheaply from the Association's approved suppliers. The laboratory tests for moulding sands exhibited were the green sand overhang test, dry sand compression and transverse, sieving, sedimentation, elutriation, Seger cones and briquettes for fusion point and refractoriness. The elutriation apparatus is shown in operation, the various grades in the sand being differently coloured to show the method of operation. The two first-mentioned control tests were demonstrated from time to time during the Exhibition.

Oil-sand cores and moulds were shown by Leyland Motors, Limited, who are amongst the pioneers in this country of the method of casting cylinder blocks, etc., entirely in oil-sand cores. A complete mould for a 2-bore cylinder block and a 6-bore cylinder head were shown, together with other motor-cylinder moulds, all in oil sand. In addition, charts were shown of the properties of oil-sand core and mould mixtures indicating the volume of gas given off by moulds on baking and effectively proving that the minimum temperature for baking such mixtures is 250 deg. C.

Coal-Dust and Blackings.

By a happy thought the organisers of the Technical Exhibit invited Mr. B. Hird to supply some specimens illustrating his Paper on " Coal-Dust and the Foundry." The samples shown were the actual castings made with varying coal-dust in the sand and also samples of the skin sand after casting and of the original mould mixture. In addition the ingenious " mica window " in the mould was shown by means of a model mould rammed up with the window in position. Mr. Hird was present on several days to explain the exhibit. A number of coal-dust samples, blackings and plumbagoes were exhibited by the B.C.I.R.A.

Casting Processes.

Brass Casting.—A series of ingot sections and photographs from the Research Department, Woolwich, showed the influence of casting conditions, mould treatment and the like on the soundness of the ingot, and this was supplemented by sections of rolled strip showing the defects in the finished product due to faulty ingots. The advantage of using a tapered ingot to secure directional solidification and consequently a sound ingot was illustrated. The use of a gas flame and soot mould dressing was shown to result in a good ingot free from surface defects. The coarse crystallisation produced by slow cooling and dissolved gases was shown by an excellent series of etched specimens. Other items in this section showed the soundness produced by the rotatory or Durville method of casting, segregation in nickel-silver and brass ingots, blowing defects produced in casting ingots, and many other important points which well merited the close attention of all interested in the melting and casting of brass and similar alloys. *Copper ingots* and the moulds in which they are poured were shown by the National Physical Laboratory, the beneficial effect of melting in a high-frequency furnace, as compared with gas or coke-fire melting, being illustrated. An excellent section on *die castings* was contributed by the N.P.L., the British Non-Ferrous Metals Research Association, and Wm. Mills, Limited. This section illustrated very clearly the necessity for correct pouring and feeding methods to secure sound die castings in aluminium alloys, and also defective casting due to incorrect venting. The harmful influence of iron absorption from the melting-pot, the influence of rapid cooling in eliminating pinholes, and many other practical difficulties which arise in making pressure and gravity die castings are illustrated by " good " and " bad " castings.

Gases in Metals.

To illustrate the influence of *gases in metals* there was also a series of castings and photographs from the same source. These showed in the main the removal of gases and the consequent pinholes by slow cooling and solidification of the alloy followed by remelting and casting. Two 9 in. dia. blocks of " Y "-alloy were of particular interest in this connection; one showed " pinholing " due to dissolved hydrogen and the other the absence of pinholes due to pre-solidification.

A diagram and photograph of an apparatus developed at Sheffield University for determining the *volume changes on solidification* of non-ferrous metals was exhibited, together with curves obtained on various alloys. A simple cone casting for estimating contraction was shown by Mr. H. C. Dews, of Messrs. Dewrance & Company, Limited, test castings in iron and gun-metal being exhibited. A series of photomicrographs by the B.C.I.R.A. showed the influence of the presence or absence of graphite nuclei in the molten cast iron on the resulting microstructure and fracture of the cast iron.

Four sectional *steel ingots* were exhibited showing the necessity for casting broad end up and the danger in casting steel which was not thoroughly killed. Macrostructures of nickel-chrome steel ingots were also shown. A mild-steel aero-engine cylinder-head casting was shown by Messrs. Lake & Elliott, Limited, one casting being sectioned up to show the typical defects encountered in making such intricate castings in steel. There was a series of *centrifugal castings* from three of the firms making these castings in this country, the exhibits including a locomotive piston valve liner, sleeve valves, cylinder liners and piston-ring pots. A series of castings illustrate Sir Robert Hadfield's early work on manganese steel.

A series of photographs and samples by Mr. D. R. Tullis showed the remarkable refining of grain produced in aluminium alloys by treating with chlorine and boron-chloride.

Special Cast Materials.

Prof. D. Hanson contributed an interesting exhibit illustrating his work on *nickel and nickel-chromium in cast iron*, the chief feature being the beneficial effect of nickel in retaining a uniform grain in thin and thick sections. A series of fractures, analyses and test results by the B.C.I.R.A. show the progressive drop in transverse strength of commercial Emmel iron, perlit iron, cylinder iron and common iron from 32.5 tons/sq. in. modulus of rupture of the first mentioned to 24 tons/sq. in. with the last, all the tests being on 1.2-in. dia. bars.

The B.C.I.R.A. also showed a sample of their new *growth-resisting cast iron* compared with common and cylinder irons after repeated heating up to 950 deg. C. This iron does not scale and only grows up to 2 per cent. A series of test bars and wedge-test fractures by Messrs. Vickers-Armstrongs, Limited, Barrow, show the influence of adding steel to cupola mixtures, and a cylinder about 4 in. internal diameter with walls about $\frac{3}{4}$ in. thick, which burst under hydraulic test at 12,500 lbs. per sq. in., shows the high mechanical strength obtainable from such mixtures. A series of photomicrographs, fractures and test specimens were exhibited by the B.C.I.R.A. to show the properties and variation in structure from edge to centre of *malleable castings*. The series included white-heart malleable cast iron, chill-cast white-heart, back-heart malleable cast iron, and " picture frame " malleable.

Aluminium Alloys.

Special aluminium alloys were illustrated by castings in " Y " alloy such as a " Lion " aircraft cylinder-head by the N.P.L., and photomicrographs and fractures of modified chill and sand-cast aluminium-silicon alloys by Messrs. Wm. Mills, Limited. This firm also showed a case containing the various metals, etc., comprising the standard light alloys in their proportionate parts for each alloy.

A number of special *high-temperature materials* developed at the N.P.L. were shown, one alloy in particular, of nickel and chromium, with

iron, carbon and tungsten additions, having a tensile strength of 30 tons/sq. in. at 800 deg. C., with a high resistance to "creep" and to oxidation. A number of *heat-resisting steel* castings for mechanical stokers, roasting furnaces, etc., were shown by Messrs. Hadfields, Limited.

After-Treatment of Metals.

The protection of metals against corrosion is an essential part of engineering practice, particularly with the light alloys. The use of *anodic oxidation* for light alloys is proving to be successful, as was shown by a series of bars which had been subjected to sea-water spray for 2½ years after treatment by the above process. The ends of the bars were left untreated, and the consequent corrosion of untreated material was very easily shown in comparison. Lanoline protection appears to be equally efficient as a protecting agent for these alloys. The tests shown were carried out by the Royal Aircraft Establishment. *Enamelling, plating* and *metal-spraying* of light castings as carried out in the Falkirk area were illustrated by the B.C.I.R.A.

Research and Laboratory Methods.

A number of standardised steel and cast-iron samples were shown, with an indication of their preparation and use for chemical analysis. The use of *spectroscopic analysis* in the laboratory for determining the quantitative chemical analysis of alloys is now within the range of practical politics, and a number of spectrograms shown by the N.P.L. indicate both qualitative and quantitative results. The *diamond pyramid hardness tester* was exhibited and demonstrations of its operation given. *Thermal analysis* was indicated by a gradient furnace and a tube for taking cooling curves in a vacuum or in a controlled atmosphere. The curves obtained by these methods were shown. That important section of metallurgical control and research which comes under the heading of microscopy is well illustrated. The N.P.L., the B.C.I.R.A., and Glasgow Technical College showed a fine series of photomicrographs of cast iron and steel, the Research Association exhibiting a series of photographs illustrating the misleading results which can be obtained by incorrect polishing and focussing when examining the graphite structure of cast iron. A projection microscope for comparing the structures of test specimens with standard structures is exhibited and demonstrated by Messrs. Vickers-Armstrongs, Limited, Erith. A special form of *dilatometer* for measuring the growth of cast iron was shown by Prof. J. H. Andrew, of Glasgow Technical College, and curves obtained by the instrument were also exhibited. The N.P.L. showed a series of single and very large crystals of aluminium produced by very slow solidification, and indicate the mode of deformation of stressed single crystals. A series of thermo-couple and optical pyrometers and recorders were shown by the leading instrument makers, and a special tungsten-molybdenum couple for molten steel and cast iron was contributed by Prof. J. H. Andrew.

An X-ray Apparatus.

The largest of the exhibits was a 200,000-volt transportable X-ray equipment for examining castings. This equipment has created a great deal of interest at the Exhibition, and more so as the apparatus was demonstrated from time to time. Radiographs taken on a steel casting ¾ in. thick showed cracks at the junction of the ribs to the main surface. In addition, it was possible to see the blowholes in aluminium ingots by viewing the image formed by the X-rays on a fluorescent screen. A number of photographs and castings were shown indicating cracks and flaws in castings which could not be detected from an examination of the surface. Many of the visitors to the Exhibition seemed to think, however, that an additional method of finding flaws was an additional straw on the back of the foundry camel. The X-ray equipment was exhibited by the Research Department, Woolwich, and the inclusion of this rather costly apparatus in the Technical Exhibit was much appreciated by all who had the opportunity to examine it. The B.C.I.R.A. showed a set of standard transverse test-bars for the new B.E.S.A. specification for grey-iron castings, and also gave the test figures required on each size of bar. In addition, a set of fractures on a cylinder iron varying from 0.5 in. dia. to 4.5 in. dia. were shown, and a chart showed the corresponding drop in transverse modulus of rupture with increasing thickness of bar.

An Official Greeting.

As previously announced, Mr. S. T. Johnston, the President of the American Foundrymen's Association, when replying at the International Congress Banquet to the toast of the guests, presented to the Institute of British Foundrymen an illuminated address of greeting. This has been photographed and is reproduced below. The sentiments expressed therein are truly indicative of the spirit actuating the foundrymen of the world through their representative technical associations. This is not the first time that the American Foundrymen's Association has utilised illuminated addresses as means of expressing their feelings, and a number of the branches of the Institute of British Foundrymen esteemed very highly this type of formal expression, when in 1926 they had the honour of entertaining a representative group of members of the American Foundrymen's Association, headed by their president, Mr. G. H. Clamer, who toured Great Britain prior to participating in the 1st International Foundrymen's Convention, held in Paris in the autumn of that year.

To the Council and Members of the
Institute of British Foundrymen
GREETING:
The American Foundrymen's Association in Convention assembled, acting with and for its membership representing twenty-five hundred American foundrymen, and by unanimous action of its Board of Directors, extends greetings to the Third International Foundrymen's Congress.
Many members of the American Foundrymen's Association journeying to London this June exemplify the spirit of friendly emulation which is fostered by the annual exchange of papers between the great foundry organizations in Europe and America. A warm feeling of fellowship in the work and accomplishments of the industry which we all serve is intensified by these triennial meetings.
Best wishes are extended for the complete success of the Third International Congress.
We instruct that this greeting be recorded on our minutes and that a copy in permanent form be delivered to the Officers and Members of the Institute of British Foundrymen, thus conveying our continued high esteem and appreciation for their hospitality on all occasions.
The American Foundrymen's Association
S. T. Johnston
President
C. E. Hoyt
Secretary
Annual Convention
Chicago, April 11, 1929

Coal-Dust as Applied to Moulding Sand.

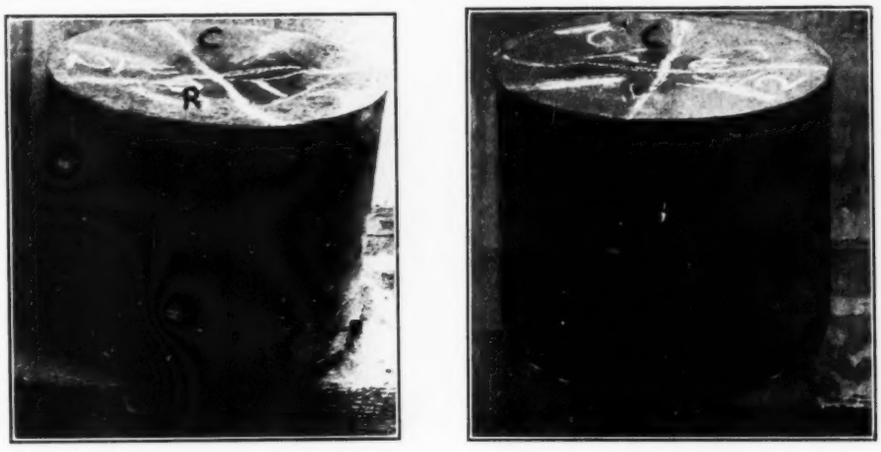
By Ben Hird, M.I.Brit.F.

(*Continued from page* 496.)

Tests on anthracite coal gave results similar to Fig. 9A. No smoke was visible, and there was no skin on the casting. Further experiments were made to prove this smoking action. Two moulds as Fig. 7 were made, each having the lower half faced with sand containing 30 per cent. addition of coal-dust, and the upper half, raw red sand, without any coal-dust. The first mould was made as described with a mica window. Iron was poured in, and the smoke could be seen rising up the mould faces. Immediately the metal reached half-way, as judged through the mica window, pouring was stopped, and the top and middle parts of the mould were instantly removed. On examination, the whole of the red-sand face of the upper half had been coated with a layer of black carbon.

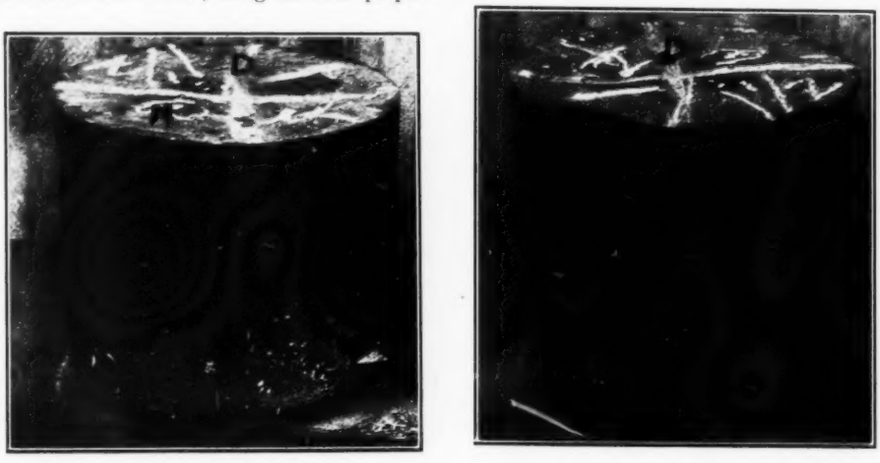
The second mould was made in the same way, but without the window, using the same proportion of facing-sand. When the casting, Fig. 10, was removed, the lower half in the coal-dust and sand had a bright and silvery skin. The upper half in raw red sand had a rough grey skin with sand burnt in.

A third mould was made with all raw red-sand facing, having the runner cut in at the bottom face and a riser off the top. In this test, immediately the molten metal entered the mould, a small ball of pitch, about ¾ in. dia., was dropped into the rising metal through the riser. Instantly thick black smoke came through the riser. This was stopped with a piece of core, which acted as a cork. Pouring was continued until the mould filled. After removing the casting from the mould, the sand was carefully examined. Most of it consisted of clear silica grains, but the sand from the face of the casting contained about 5 per cent. black-coated silica grains. After cleaning with a wire brush, the casting had a fairly good blue skin. On one side, near the bottom, there was an indentation in a patch of silvery skin, with some shiny carbon flakes, where some of the pitch had melted, run to the side and been trapped by the rising metal. This suggests that the deposit of these shiny carbon flakes on the casting and mould-skins are due to the excessive deposition of volatile matter between the two faces.



Sections R—O. Sections P—Q.

FIG. 4.—SOLID CYLINDERS.



Sections N—K. Sections L—M.

FIG. 5.—SOLID CYLINDERS.

These experiments seem to prove that the carbon deposit on the skin of the mould, created by the smoke from the coal-dust, has only a preliminary and slight influence on the colour and quality of the casting skin.

As the previous mica-window tests were all made on the vertical faces of the moulds, further experiments were carried out to find the action of coal-dust on the bottom horizontal faces. It was impossible to take photographic records of these tests, because it was necessary to make a lengthy time exposure. The impressions closely observed through the mica window are shown in Fig. 11. "A" represents the mould cavity, B the flowing metal, and C the slight smoke from the coal-dust. The advancing metal forms a very pronounced meniscus, which gives a rolling motion to the flow. Between the advancing metal and the slight coal smoke there appeared to be a clear space, similar to that seen in the

FIG. 6.

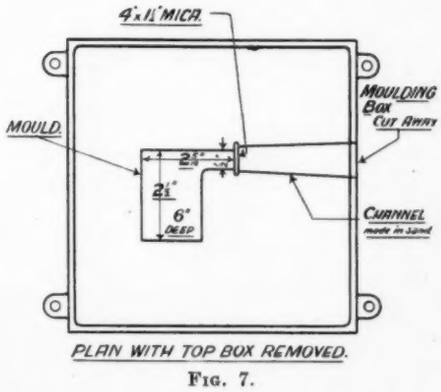


FIG. 7.

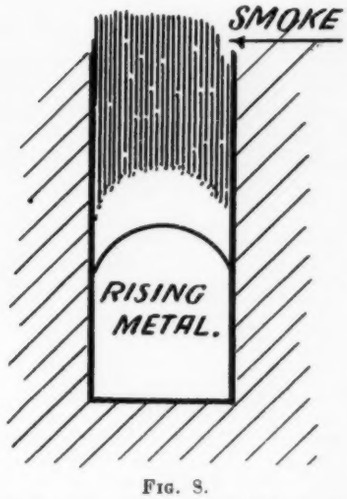


FIG. 8.

"vertical" experiments. Here, again, the trapping of a smoke pad by the advancing metal is not very noticeable.

Carbon Absorption.

A test was made on casting Fig. 10 to ascertain if any of the carbon deposit from the coal-dust was absorbed into the casting skin. About $\frac{1}{32}$ in. depth of skin was removed with a file from faces A and B and C and D of Fig. 10. Separate analyses were taken for total carbon, which gave the following results:—A-B (coal-dust and sand skin), total carbon = 2.086 per cent.; and C-D (red-sand skin), total carbon = 1.895 per cent., showing a gain of 0.181 per cent. total carbon, or almost 10 per cent. in that part of the casting made in a facing sand to which 30 per cent. coal-dust had been added. These results suggest that carbon is taken up from the coal gas during the high temperature of the casting, before final solidification has set in. This is probably the reason why coal-dust, added to the sand for facing mild-steel castings, does not operate in the same way as it does with high-carbon steel and grey-iron castings.

The Action of Coal-Dust on the Casting Skin.

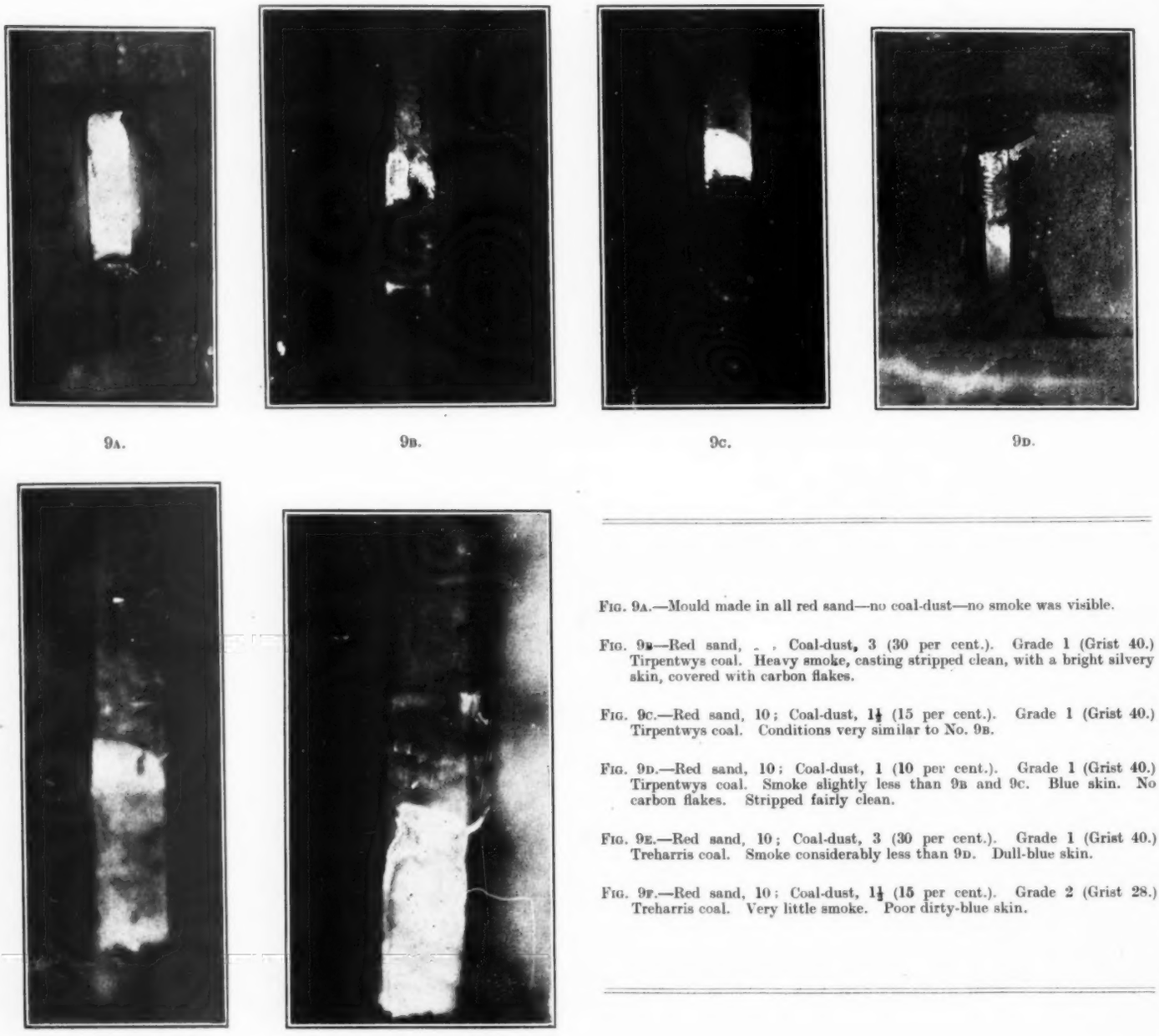
The following explanation of the action of coal-dust on the skin of the casting is advanced as a result of these experiments.

The radiant heat immediately preceding the advance of the molten metal causes the coal-dust to give off its volatile matter in the form of smoke. This condenses on the inner surfaces of the mould and coats them with a carbon deposit, thus forming a preliminary protection to the sand grains. As the advancing metal covers this active coal, the smoke impinges upon the skin of the casting, thus creating a carbon film between the metal and the sand. This reaction of the coal continues throughout the solidification range of the metal.

As the heat penetrates deeper into the face of the mould, more coal-dust is decomposed, evolving more gas. Under pressure of expansion the smoke follows the line of least resistance. The bulk of the smoke percolates through the pores and vents of the mould into the open. Some continues to keep contact with the casting skin, where, due to the high temperature, it is transformed into fixed carbon, which is deposited on to the casting and sand grains of the mould skin when the percentage of fine, high-volatile coal-dust exceeds a certain ratio. A small percentage of carbon is absorbed into the skin of the casting.

The Action of Coal-Dust on the Sand.

The sands referred to in this Paper as "skin sand" and "behind skin sand" apply to the sand on the face of the mould, and that immediately behind the face, say, from $\frac{1}{4}$ to $\frac{1}{2}$ in. thickness. These skin sands, being carbon-coated, will give a fairly good blue skin to a casting when damped down and used again. They are useless as a facing sand by themselves,



9A. 9B. 9C. 9D.

9E. 9F.

Fig. 9.—Mica Window Photographs.

Fig. 9A.—Mould made in all red sand—no coal-dust—no smoke was visible.

Fig. 9B.—Red sand, , Coal-dust, 3 (30 per cent.). Grade 1 (Grist 40.) Tirpentwys coal. Heavy smoke, casting stripped clean, with a bright silvery skin, covered with carbon flakes.

Fig. 9C.—Red sand, 10; Coal-dust, 1½ (15 per cent.). Grade 1 (Grist 40.) Tirpentwys coal. Conditions very similar to No. 9B.

Fig. 9D.—Red sand, 10; Coal-dust, 1 (10 per cent.). Grade 1 (Grist 40.) Tirpentwys coal. Smoke slightly less than 9B and 9C. Blue skin. No carbon flakes. Stripped fairly clean.

Fig. 9E.—Red sand, 10; Coal-dust, 3 (30 per cent.). Grade 1 (Grist 40.) Treharris coal. Smoke considerably less than 9D. Dull-blue skin.

Fig. 9F.—Red sand, 10; Coal-dust, 1½ (15 per cent.). Grade 2 (Grist 28.) Treharris coal. Very little smoke. Poor dirty-blue skin.

because, having no bond, the sand swills in front of the metal. Therefore, it must have a certain amount of new sand added to make it usable. The sand behind these two skins still retains most of its bond, and the whole mixed together is usable for a period, becoming weaker and weaker with each succeeding cast.

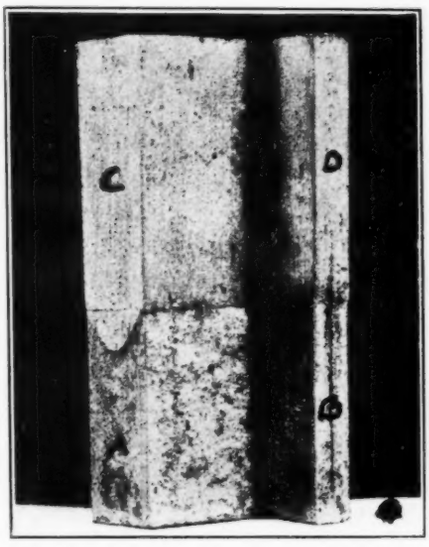


FIG. 10.

"Skin Sand."

The condition and appearance of this sand, which forms the mould face, varies considerably.

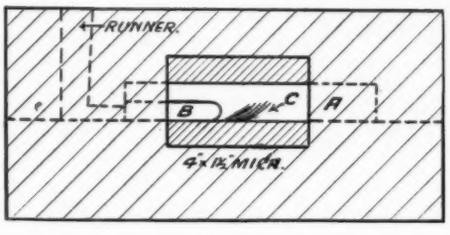


FIG. 11.

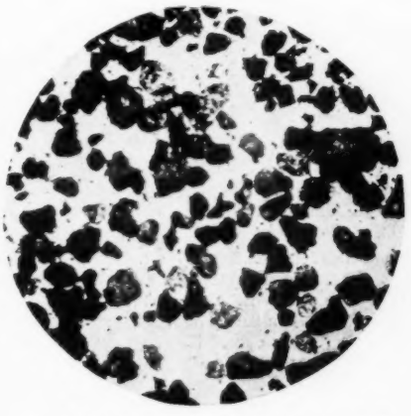
A study of the Tables I and II shows the increased coking effect produced by the fine coal with a high-volatile content. Also, the finer the coal-dust, the more compact this coked skin becomes. Fig. 12 shows two pieces of sand from sole-plate mould No. 3 (Table I and Fig. 2).

FIG. 12.

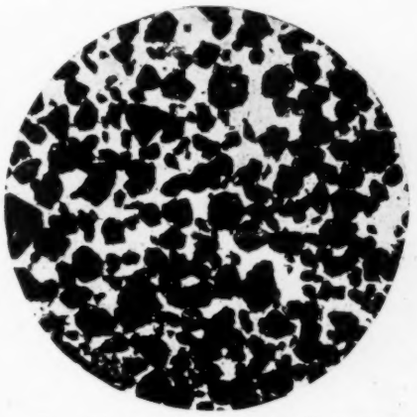
The depth of the coking can be seen in the section, and the bright silvery appearance in the plan. With Grades 2 and 3, this coking is more coarse, and much weaker in structure. Coking does not occur with the lower volatile coals. There is a very distinct difference of condition and appearance between this skin and the sand immediately behind it, with the exception of some mixtures containing only 5 per cent. additions of coal-dust.

Immediately Behind the Skin Sand.

The exact position of this sand from the face of the casting varies with the depth of the coking or matting (cohering) of the skin sand. In Fig. 12 it is the deep-black central portion in the section. Where coking is present in the "skin" sand, it consists of carbon-coated sand, partly-coked coal, matted together by the tar from the partly-coked coal and that left by the distillation of the smoke from the coked coal in

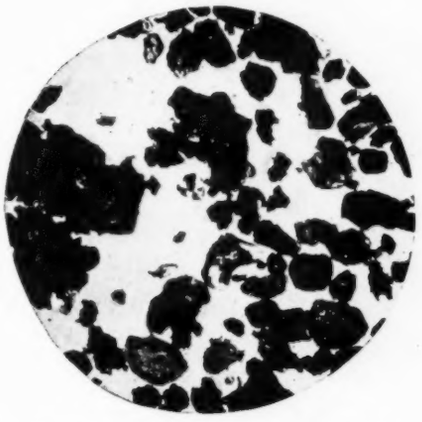


VA.—Bright Silvery Carbon-coated Grains, Black Carbon-coated Grains and Coked Coal.



VB.—Black Carbon-coated Grains and some Matted, with Partly-coked Coal Grains.

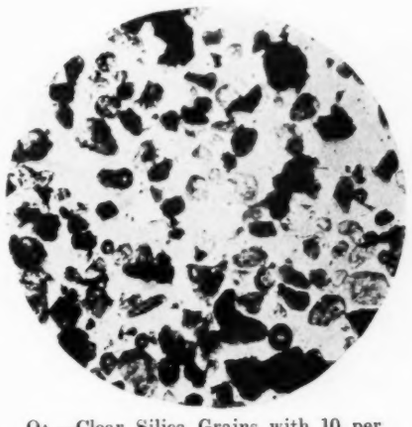
FIG. 13.



RA.—Clear Silica Grains with 50 per cent. Matted Black Carbon-coated Grains.

RB.—Matted Black Carbon-coated Grains.

FIG. 14.



QA.—Clear Silica Grains with 10 per cent. Matted Black Carbon-coated Grains.

QB.—Matted Black Carbon-coated Grains.

FIG. 15.

the skin sand, as it filters its way through to the open. With the exception of the 5 per cent. coal-dust additions previously mentioned, these sand grains are always more heavily coated with deep-black carbon than the grains in the skin sand. The photomicrographs, Figs. 13, 14 and 15, show this very clearly. V_A, R_A and Q_A are taken from the "skin sand," V_B, R_B and Q_B from "behind-skin" sand of the castings B and C, Table II and Figs. 3 and 4.

Photomicrograph Fig. 16 of section "O" in Table II shows the exceptions where the "skin" and "behind-skin" sands have the same characteristics. Photomicrograph Fig. 15 represents sand from Section Q, Table II. This shows another peculiarity. The "skin sand" (A) consists of a large proportion of clear silica grains. The grains of the "behind-skin" sand (B) are all-black, carbon-coated and matted. Comparing this with No. 5, Table I (containing the same facing-sand mixture) shows a very pronounced difference, which is emphasised by further comparisons on the same lines with other tests in Tables I and II, *i.e.*, S with 1, O with 4, K and M with 7 and 8.

These comparisons support the statement that superfine coal-dust is the most efficient for heavy as well as light work; that coarse-graded coal-dust, unless used in large proportions, when they cause other blemishes (such as pock-marks and ratching), are too widely distributed amongst the sand grains to function properly, and leave much of the sand on the mould faces unprotected or so slightly covered that the coating is burnt off by the heat of the metal. Therefore, coal-dust, as its name implies, must be the *dust of coal*, and for all classes of work should be of a "superfine" quality that would pass through a 40-mesh to the linear-inch sieve. Also, the volatile content should not be less than 30 per cent., *i.e.*, a bituminous coal. This action of the volatile matter in the coal during the casting of the mould explains the reason why used foundry sand is black, when coal-dust is mixed with the facing sand. This can easily be proved by burning the black "used sand" in air. The carbon film will burn off, leaving a brown or grey silica grain, such as is left on the top of an open sand plate when a thin layer of black sand has been thrown on after casting.

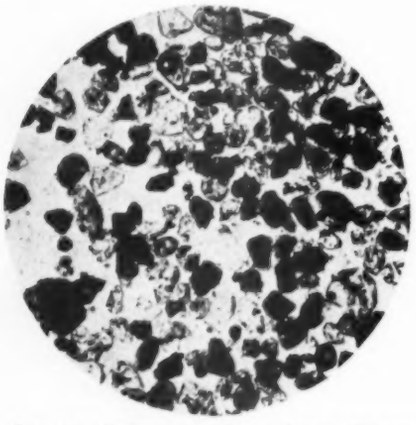


Fig. 16.—Section O. Clear Silica Grains and Carbon-coated Grains.

The author desires to thank Mr. W. R. D. Jones, of the Department of Metallurgy, University College, Cardiff, for his assistance and the photomicrographs of the sands. Also the British Cast Iron Research Association for the tests of the red sand.

Premix Gas Plants, Limited, of York Mansion, Petty France, London, S.W.1, announce that they have recently supplied to various industrial undertakings installations having an aggregate capacity of nearly 300,000 cub. ft. per hr.

Standardisation of Trade Customs in American Grey-Iron Industry.

The Grey Iron Institute, of Terminal Tower Building, Cleveland, America, announces the adoption of a standard sales agreement and trade customs in the grey-iron industry.

The Merchandising Committee of the Institute prepared the standard sales agreement and trade customs, and the approval of the Board of Directors of the Institute has been given to the findings of the Merchandising Committee, which state that all quotations are made and all castings are sold upon the following terms and conditions:—

(1) Unless otherwise agreed, quotations must be accepted and patterns furnished to the foundry within thirty days from the date of quotation; (2) all castings are sold as rough castings, f.o.b. cars, foundry point. Terms, thirty days net, from invoice date, unless otherwise stated; (3) Claims for error in weight or number must be made within five days after the receipt of castings; (4) the foundry is responsible only to the extent of replacing castings rejected due to foundry defects, and such castings must be reported or returned to the maker within ninety days of their receipt; (5) the foundry is not responsible for machine work, labour charges or other losses or damages caused by defective castings; (6) the foundry is not responsible for loss of or damage to patterns by fire or other casualties beyond its control; and (7) the foundry shall not be liable in damages for failure to deliver as a result of fires, strikes, differences with employees, accidents or other causes beyond its control.

The purpose in setting forth these trade customs is to establish between the customer and the foundry a complete understanding of those conditions peculiar to the grey-iron foundry business. They are not presented as a "Code of Ethics," for the Committee believes general business ethics are so well established and understood that further elaboration is not necessary. Frequently, honest differences of opinion arise, and it is hoped that a statement of this kind outlining the generally accepted customs will serve as a basis of settlement between customer and supplier in these cases.

Quotations.

(1) Blue prints submitted for estimating purposes should be marked with rough casting weight, if known, or an estimated weight upon which quotation will be based. A detailed description of the pattern equipment should be furnished; (2) when quotations involve the making of piece prices, definite weights shall be established and agreed upon, and quotations shall be subject to revision on any variation from the established weights; and (3) unless otherwise specified by the foundry, quotations are based on castings with gates, fins and other projections removed to approximately the contour of the pattern.

Orders.

(1) No order shall be changed unless notice of revision is made and accepted in writing before work is in process. If work is in process, the customer is to be charged for any castings made as well as the cost of cores, moulds or equipment discarded because of such changes; (2) cancellations of orders are to be made only by mutual consent of buyer and seller; (3) unless otherwise stipulated, the customer shall accept an overrun of 10 per cent. above quantities specified on the order. However, the foundry is to make an effort at all times to furnish as near the exact quantity specified as operating conditions will permit; and (4) if the customer requires special production service to secure unusual deliveries, an extra charge shall be made.

Patterns and Core-Box Equipment.

(1) The customer must supply equipment in condition to produce economically the quality and quantity of castings required; (2) an extra charge will be made if patterns require stopping off or if skeleton or sweep pattern equipment is furnished; (3) the foundry is not responsible for variations existing between blue prints and equipment supplied by the customer; (4) all patterns, core-boxes and loose pieces thereof should be marked properly for identification; (5) follow boards, core driers and similar devices, when required, are to be furnished by the customer; (6) repairs and changes to patterns by customers' orders will be made at expense of the customer; (7) all freight drayage, boxing and crating charges of patterns, both to and from the foundry, shall be assumed by the customer; and (8) pattern-storage facilities are provided by the foundry for active patterns only. Patterns not in use for a period of six months will be returned to the owner or will be subject to storage charges.

To ensure the elimination of error, the following recommendations, agreed to by other outstanding organisations of the foundry trade, are made:—

Patterns are to be painted the following standard colours:—Unfinished surfaces, black; machined surfaces, red; seats of and for loose pieces, red strips on yellow background; core prints and loose core-print seats, yellow; and stop-offs, diagonal black strips on yellow base.

Factors in Successful Cupola Practice.

Addressing the May meeting of the New England Foundrymen's Association, Dr. Edward E. Marbaker, director of the foundry research division of the Whiting Corporation, outlined the many factors required for copper control and most efficient operation of the cupola. Amongst the points dealt with were the following:—

Improper combustion of the gases in the cupola is a chief factor in poor castings. The grey-iron cupola offers advantages for nearer perfect combustion of fuel than any other form of melting iron, but too much reliance is placed on the clumsy method of trial and error. It is faulty combustion of fuel when a yellow flame is seen at the charging door. When too much air is delivered in proportion to coke, oxidation of metal takes places; too little results in insufficient combustion. With a cupola melting efficiently, the best quality of castings will be produced.

The use of expensive machinery for recovering wasted CO he thought decidedly less preferable to finding theoretically perfect operating conditions for the cupola and approximating that in practice as nearly as possible.

The question of large or small coke was discussed and Dr. Marbaker reported that a four-inch size seemed average. Too dense coke impedes the blast; too large coke permits egress of air, pushing out unconsumed gas and oxidising the iron. Breeze in coke is fatal for cupola practice, and a happy medium as indicated is the best.

Factors in the air supply, such as expansion of air when hot as in summer, should be considered. More air is required by volume in summer than winter for this reason, and foundries refusing to recognise variant are making up for it in coke consumption.

The business carried on at Sunderland by the late Mr. George W. Robson, iron and steel and bolt and nut merchant, has been taken over by Messrs. Wight & Company, Limited, Wear Dismantling Works, Pallion. It is understood that it is their intention to reorganise the business and carry it on in conjunction with their other activities.

Die Casting.

By A. H. Mundey (Member.)

(*Continued from page* 488.)

Tubular Castings.—The general form of cast-iron mould is shown in the illustration Fig. 2. After experimental work a set of conditions was reached which enabled the operators to overcome such difficulties as incomplete filling of the mould, sticking of cores, air-locks, cracking and breaking and internal and external shrinking. To effect this it was found necessary to regulate: (1) Temperature of the mould; (2) temperature of the metal on pouring; (3) time taken to fill the mould; (4) period of waiting, if any, before drawing cores after solidification had occurred; and (5) period of waiting, if any, before final stripping.

The Y-alloy gave less trouble than the others, as it was less hot-short and gave a greater latitude as regards temperature limits. The 12-per-cent. silicon alloy is relatively tough at high temperatures, but is subject to localised shrinkage.

Figs. 3, 4, 5, 6 and 7 illustrate the difficulties encountered in the production of the tubular casting. The tests carried out on these castings were:—(1) Tensile tests; (2) density measurements; (3) microscopic and visual examination of sections; and (4) porosity tests with water and with petrol under pressure. The results of tensile testing are set out in Table VI:—

TABLE VI.—*Mechanical Properties of Tubular Castings.*

Alloy.	M.S. Tons per sq. in.	E. Per cent. on 0.44 in.
"Y" (as cast)	13.2	3.5
"Y" (heat-treated) ..	15.0	3
Cu 4 per cent. (as cast)	10.0	10
Cu 8 per cent.	12.5	6
Si 12 per cent.	11.6	7 (modified)
Si 12 per cent.	10.6	8 (unmodified)
Cu 4 per cent., Si 3 per cent.	10.7	2

The 12-per-cent. silicon and the copper-silicon alloys yielded sound castings with good density values and an absence of cavities. All the castings were subjected to a hydraulic pressure test, up to 1,000 lbs. per sq. in., for 30 mins. All withstood this test without leaking. Mr. H. J. Lavender also permitted at his works a special test of all these castings (with the exception of the copper-silicon alloy) with petrol at 30 lbs. per sq. in. The 4-per-cent. copper alloy revealed a fine crack; the others passed successfully.

Copper Rich Alloys.

The investigation by Genders, Reader and Foster into the die-casting of copper-rich alloys, dealt with a large range of alloys which had either been in actual industrial use, or, from their known properties, offered a promising field for selection of material for this work. The selection of mould material was also investigated with great care. It was shown that low carbon and general engineering steels were rapidly attacked. High-carbon and heat-resisting steels withstood the action of the molten metal, both still and in rapid motion, fairly well, but the highest-grade alloy-steels were required for severe service. Cast iron in contact with aluminium-bronze is required to be low in phosphorus.

The alloys used in the very large series of tests were:—A series of chill-cast test-bars was prepared under varied conditions and their mechanical properties closely investigated and compared with die-cast test-pieces, both flat and round.

The chill castings were:—(A) Aluminium-bronzes with added iron; (B) aluminium-bronzes with added nickel and with nickel and iron; (C) aluminium-bronzes containing manganese and manganese and iron; (D) complex aluminium bronzes; (E) brasses with added iron; (F) brasses containing nickel; (G) high-tensile brasses; and (H) nickel-brasses with added aluminium.

These were cast at about 150 deg. C. above the liquidus of the alloy into a cast-iron stick-mould giving a casting of about 1 in. dia., 8 in. long, with a taper of 0.1 in. The die-cast test-pieces were made so that a round and a flat test-piece were attached; one end was elongated in each case, which enabled a piece to be cut off for other tests. These were:—(1) Aluminium-bronze; (2) aluminium-bronze, with varying percentages of iron; (3) aluminium-bronze containing 2 per cent. of lead; (4) aluminium-bronze containing 7.5 per cent. of nickel; (5) aluminium-bronze containing iron and manganese; (6) high-tensile brass (copper 58, zinc 35, aluminium 3, manganese 4 per cent.); and (7) aluminium-nickel-zinc-copper alloy.

All of these alloys were also used in the preparation of die castings using moulds of various design as in commercial practice. The alloys containing zinc showed less "fluidity" than those based on "aluminium-bronze," and consequently required in some moulds a runner of larger cross-section.

The results of the exploratory work suggest that a large range of useful alloys is available for adaptation to die-casting manufacture, fulfilling requirements for materials either of low strength or high ductility. The alloy containing 1.5 per cent. of aluminium with iron and manganese was observed to give particularly good surface-quality.

The effect of added iron up to about 4 per cent. on "aluminium-bronze" is to increase the maximum proof-stress and tensile-strength of the die-cast alloy. Nickel added to the extent of about 10 per cent. raises the maximum proof-stress to a greater extent, but is accompanied by a marked lowering of the ductility. The addition of iron and nickel together to 12-per-cent. "aluminium-bronze" produces a strong alloy having a tensile strength of about 50 tons/sq. in; this type of alloy was the only one tested showing distinct liability to cracking in the double test-piece mould. The total shrinkage of this alloy (about 2.4 per cent.) is greater than that of all the remaining types tested ("aluminium-bronze" about 2 per cent., high-tensile brass about 1.9 per cent.), and its utility would probably be limited to castings of simple form. "Aluminium-bronze" is weakened slightly by the addition of lead, which also appears to introduce small surface defects. The

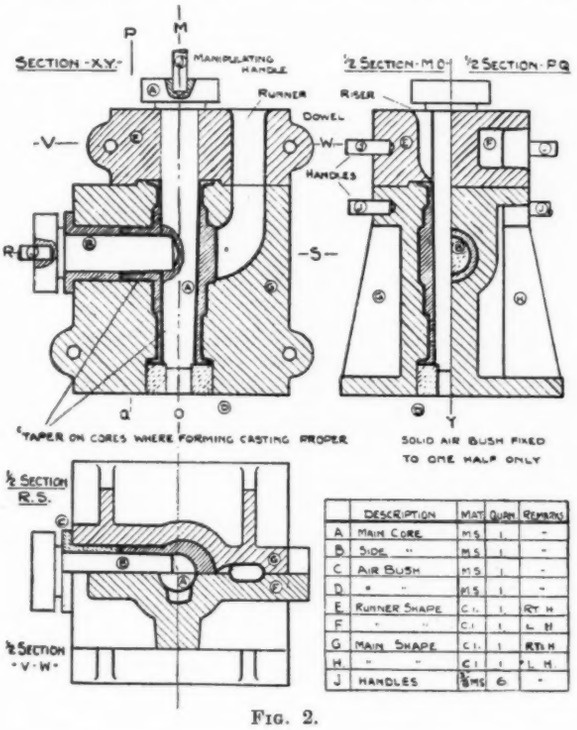

SECTION - X.Y.
½ SECTION - M.O.
½ SECTION - P.Q.
MANIPULATING HANDLE
RUNNER
RISER
DOWEL
HANDLES
TAPER ON CORES WHERE FORMING CASTING PROPER
SOLID AIR BUSH FIXED TO ONE HALF ONLY
½ SECTION R.S.
½ SECTION V.W.
DESCRIPTION | MAT. | QUAN. | REMARKS
A MAIN CORE | M.S. | 1 | -
B SIDE " | M.S. | 1 | -
C AIR BUSH | M.S. | 1 | -
D " " | M.S. | 1 | -
E RUNNER SHAPE | C.I. | 1 | RT. H
F " " | C.I. | 1 | L. H
G MAIN SHAPE | C.I. | 1 | RT. H
H " " | C.I. | 1 | L. H
J HANDLES | M.S. | 6 | -

FIG. 2.

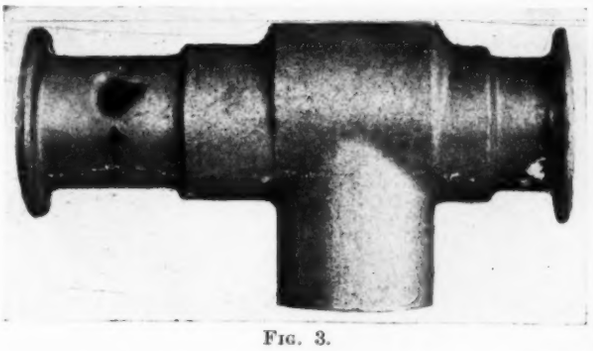


FIG. 3.

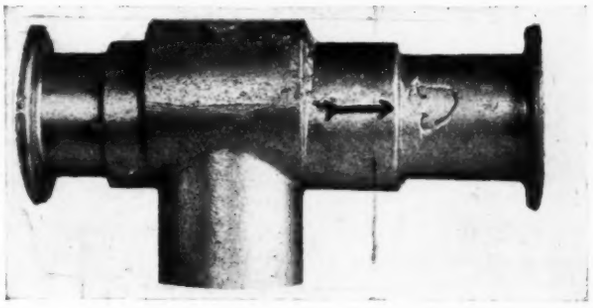


FIG. 4.

high-tensile brass included in the tests showed mechanical qualities as high as those of the alloys related to "aluminium-bronze." The nickel-brass (Cu-Zn-Ni alloy), containing aluminium, gave a high ratio of proof-stress to breaking load. The machining qualities of the alloys have not been considered in detail, but none of the castings made gave any great difficulty in turning or sawing. The "aluminium-bronze" containing lead appeared slightly easier to machine than the other alloys.

Many tests on brasses, 70 Cu : 30 Zn; 60 Cu : 40 Zn; and 55 Cu : 45 Zn; each with added aluminium, were made with both 60 per cent. copper and 70 per cent. copper alloys with about 4.0 per cent. of aluminium replacing a corresponding amount of zinc, about 40 tons maximum load is obtained. Some comparative results of tests of die-cast test-pieces are given in Table VII.

The results of these investigations, which were carried out with all the care and precision of highly-trained workers in the best scientific conditions possible, confirm the author's personal experience obtained in practice. He finds that when a new die is put into operation that there is almost invariably a period of trial whilst small corrections are made, adjustments of gates and vent effected, before the most skilful workers are able to produce regularly and continuously satisfactory castings. As regards aluminium alloy, he is fairly convinced that if satisfactory castings cannot be produced under commercial manufacturing conditions in 12-per-cent. silicon alloy, they cannot be produced at all, for as a general rule they are less liable to "hot-shortness"; they are easier to cast, have good tensile strength, generally greater elongation and impact values, and are more resistant to corrosion.

Capt. Mortimer compares aluminium-alloy die-castings produced by pressure and gravity methods. In his opinion gravity castings will always have superior mechanical properties to those cast under pressure. This view is based upon the argument that in gravity die castings the flexibility of the pouring-rate enables the crystalline shrinkage to be taken up by the automatic feeding from the molten layer above. In pressure die castings the metal is shot into the mould and the shell in contact with the walls of the die solidifies instantly, leaving a space between two thin castings which sets to an open porous structure within a beautifully finished exterior.

From this it would appear that (A) gravity die castings are preferable when the mechanical properties of the finished casting are the chief consideration and (B) pressure die castings are to be preferred where accuracy of dimension and the elimination of machining are of first importance.

In spite of these conclusions, with which one is bound to agree in some measure, the very marked success achieved by the author's works in the production of die castings in air-pressure machines makes one feel that there is little to be desired as to soundness of castings when prepared under the best conditions. Much industrial research has been done to overcome all the difficulties by the Doehler Die Casting Company in the U.S.A., by some firms on the Continent, and by the author's colleagues in Fry's Metal Foundries, Limited.

Air-pressure machines are also employed with the most gratifying results with zinc-base alloys, especially those of the copper-aluminium-hardened series, which possess high tensile strength with good elongation. Some general working data for aluminium pressure die castings is given by the Doehler Company as under: *Maximum weight*, 5 lbs.; *maximum limits for wall thickness*, $\frac{1}{16}$ in. for small castings and $\frac{1}{8}$ in. for large castings; *variations from drawing dimensions*, 0.0025 in. per in. of length or diameter; *holes*, 0.093 in. minimum diameter and not deeper than 1 in. (smaller holes may be "spotted"); *draft*, cores 0.075 in. in length or diameter; and *side walls* 0.005 in. These rules are good for general design purposes, but the limits may be improved upon in certain cases.

It is largely due to the work of Dr. A. G. C. Gwyer, Chief Metallurgist of the British Aluminium Company, that the aluminium-silicon alloys have been developed so rapidly. He has, together with other eminent workers in this country and in Germany and America, studied with great persistence the phenomenon known as "modification." It was found that the addition of certain elements, particularly sodium and some of its compounds, to aluminium-silicon alloys when in the molten condition caused a very marked change in the crystalline structure of the metal.

It was also found that this modification was accompanied by greatly improved physical properties, to a limited extent in the tensile strength, but more particularly in the elongation and resistance of shock. These phenomena belong to the realm of physical metallurgy, and it is suggested that members who are keen to follow up the theoretical consideration of the subject should study Dr. Gwyer's Paper, printed in Vol. XXVI of the "Journal of the Institute of Metals." Dr. Gwyer's work emphasises the

TABLE VII.—*Tests of Die-Cast Test-Pieces.*

Material.	Maximum proof stress. Tons per sq. in.		Maximum load. Tons per sq. in.		Elongation. Per cent.	
	Round piece.	Flat piece.	Round piece.	Flat piece.	Round piece.	Flat piece.
Aluminium-bronze (Cu 89.6, Al 10.4) ..	10.2	14.3	33.6	28.4	23	5
Iron-aluminium-bronze (Cu 87.8, Al 10.2, Fe 2.0)	12.1	13.0	33.4	35.0	14	10
High-tensile brass (Cu 59.2, Al 3.5, Zn 33.1, Mn 4.2)	27.9	20.7	41.8	38.0	7	4
Aluminium-brass (Cu 59.9, Al 3.5, Zn remainder)..	21.4	18.6	42.0	33.2	7	4
Aluminium-brass (Cu 69.2, Al 4.3, Zn remainder)	19.1	21.7	37.6	36.1	17	7
Pure 60 : 40 brass (Cu 59.6, Zn remainder) ..	7.6	9.0	24.0	25.3	29	28

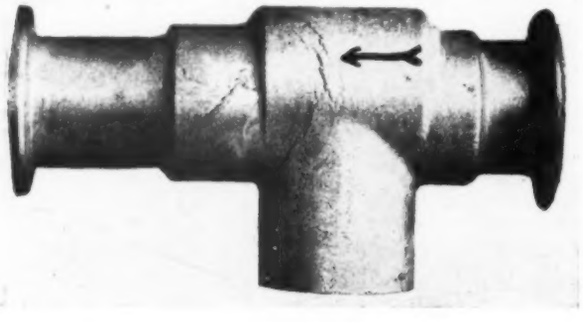


FIG. 5.

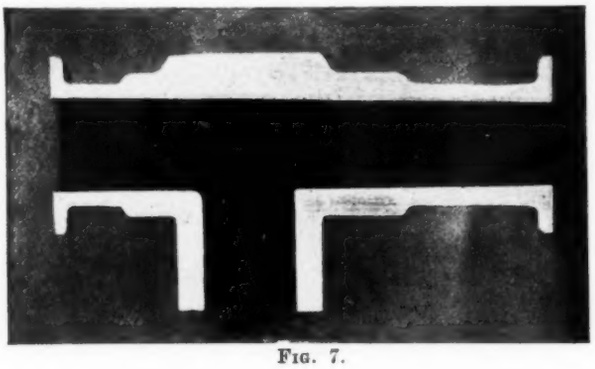


FIG. 7.

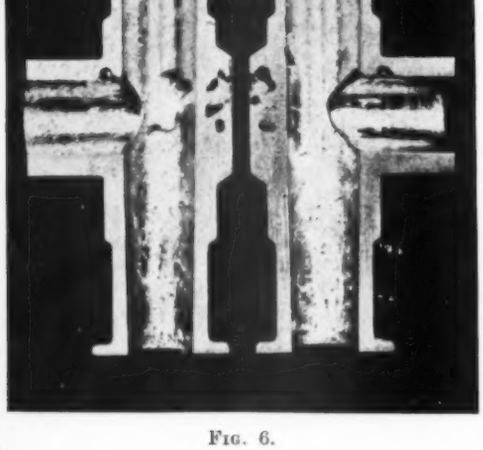


FIG. 6.

TABLE VIII.

	M.S. Tons per sq. in.	E. Per cent. in 2 in.	Impact. Ft.-lbs.	Specification.
3L.11..	9–11½	3–4	1.2–1.6	2.87
2L.5 .. 11 per cent. Si mod.	11–15	3–9	2.5–3.0	3.01
	13–14	10–15	6–8	2.66

value of the most advanced theoretical research in relation to its application to industry.

The comparison between the modified 11-per-cent. silicon alloys and the well-known industrial alloys 3 L.11 and 2 L.5 as to physical properties is shown in Table VIII.

It will be noticed that the Izod impact-figure shows a very marked improvement. The total linear contraction is about the same in each of these alloys, but the crystallisation shrinkage is much less in the modified alloy. It is easier to make good castings as it fills the moulds. It is not hot-short to such an extent; it is, therefore, easier to remove from the mould. It is less corrodible than most unmodified aluminium alloys.

Much excellent work has been done with regard to these alloys by the Light Alloys Company, Limited. Mr. Deeley's valuable Paper on Alpax, read before the London Sections of the Institute of British Foundrymen and the Institute of Metals, did much to inform industry as to the value of this process in the case of die-castings as well as ordinary sand castings.

Magnesium Alloys.—Two or three years ago, Mr. W. R. D. Jones presented an important Paper to the Royal Aeronautical Society on "Magnesium and its Alloys." In it he compared the physical and mechanical properties of these alloys with those of aluminium and also a number of other metals. The special attractions are the low density and the high specific heat, also the relatively high conductivity of heat and electricity. Magnesium is considerably lighter than aluminium; it is 1.74 as compared with 2.7, whilst the melting points are almost identical—651 deg. C. and 658.7 deg. C. respectively.

Magnesium in the cast state is stronger than aluminium, but an important proposal of Rosenhain and Archbutt to consider the "specific tenacity" obtained by dividing the tensile strength in tons per sq. in. by the weight in pounds per cub. in. gave magnesium a much higher value than aluminium.

Mr. E. Player, of Coventry, recently reviewed at a joint meeting of Metallurgical Societies at Birmingham the properties of magnesium castings. He stated that by pressure die casting these alloys can be produced in fine sections. The strength of castings in magnesium alloys is increased by forging. It is claimed that the physical properties are greatly improved by the addition of calcium. Chill castings thus modified by the process invented by M. G. Michael are said to have lost the characteristic coarse grain and to have assumed a so-called fibrous condition. In this state both thermal and electrical conductivity are said to be enhanced. The metal treated by this process by the Maxium Company is used for pistons with great success.

The well-known alloy, elektron, used largely by Germany during the war for aircraft, contained from 5 to 6 per cent. zinc, together with small proportions of copper, aluminium and iron, gave good chill castings, having a tensile strength of 12 to 14 tons per sq. in.; it forged and pressed well, and was capable of heat treatment. Magnesium with 6 per cent. of aluminium is found to be a good useful alloy. Casting and machining magnesium and its alloys are attended with many workshop difficulties; not the least is the inflammability of the turnings and fine cuttings of the metal. Elektron car and trolley wheels are largely used in Germany.

The circumstances connected with the production of die castings are such that the industry never came into the hands of the orthodox foundryman as a part of his regular practice. It may in view of this fact be well to consider for a moment the type of labour engaged.

Die Design.—This work is the most important of all, as engineering draughtsmen of great ingenuity and experience are needed. They must possess imagination as well as knowledge of properties and behaviour of the metals whilst in the fluid and transitional stages to complete solidification. They must be adaptable and have the knack of interpreting the ideas of the customer who sometimes asks for an article which is either impracticable or at least uneconomic.

Next is the *die-maker*, who must be a high-class fitter and machinist, who must be able to make adjustments in difficult conditions, and to anticipate, as well as to overcome, "snags" in production.

Finally the casters. It is a mistake to imagine that tools and machines can be made so fool-proof that any unskilled or casual operator can produce good, sound castings at an economic rate. A capable and experienced caster is a valuable man.

The metallurgist has not been mentioned, but it is worthy of note that the men in charge of all successful die-casting establishments are highly-trained metallurgists with a good knowledge of engineering practice or engineers with a sound knowledge of metallurgy. In such cases a full use and appreciation of the laboratory follows inevitably.

It is with a feeling of great gratification that the author is able to report that his company, Messrs. Fry's, recently acquired a new process in the manufacture of die castings in yellow metals, which promises to revolutionise this section of the industry. At the moment of writing it is not possible to give intimate details, but it is anticipated that specimens will be shown at the meeting and that particulars of the principle and methods will be available. The improvements and modifications have passed far beyond the experimental stage, and the results in actual manufacturing conditions are overwhelmingly satisfactory.

A Method of Utilising Waste Sand.

In many large foundries one can see entering the yard a flow of Portland cement, gravel, and other materials, for yard, road, and rough floor construction, and a big tonnage of spent and waste sands, leaving it to be dumped. The anomaly is largely because cement cannot be economically used with such very fine, dirty sand, but around many big foundries there are so many acres of places in which this sand could be used if a satisfactory and cheap binding material were available. We learn that for rough floors, patches, car-tracks or potholes to be filled in on existing roads and passages, or even new roadways to be made; yards to be levelled and raised; tennis or sports courts to be laid or recovered for employees, etc., there is now a non-plastic but eminently hydraulic line available. This is made by the Slag Reduction Company, Limited, of The Ickles, near Rotherham, as a by-product. It will make this waste of sand unnecessary, and put into the hands of foundry owners a means of doing many jobs with their own waste materials. The method is simple, the cost is low, and the finished surface is good for even the heaviest horse or motor traffic in all weathers. The best way to do the work is to mix waste sand in equal proportions with this lime waste and spread it dry. It hardens by rain and by traffic. There is no dislocation, no waiting, and hardly any cost. It is available in good tonnage for almost free loading charges, and the railway charge only Class A rates for freighting it.

The use of these materials in the manner suggested is a case of simple co-operation between two parties, both of whom were dumping tons of material which was going waste, until the two were used together to make a serviceable product. There is, furthermore, always the opportunity for those firms with too much waste sand for their own use to sell the mixture to local bodies for rural pathways, by-roads, etc.

Malmö Industrial Fair.—The eleventh Industrial Fair will be held at Malmö from August 5 to 11. Each year this fair has attracted an ever-increasing number of traders.

Publications Received.

We have received from the Metropolitan Life Insurance Company of New York a series of eight pamphlets (a further two are promised) entitled "Better Foundry Practice." They state, "The primary purpose of the study was to equip the Policy Holders' Service Bureau to be of practical assistance to Metropolitan group policyholders in the foundry industry." Candidly, we fail to appreciate why a life insurance company should sponsor such an undertaking. There are recognised channels for purvey of this type of information. There exists in America an enlightened technical Press, an efficient foundry technical association and one of the best-conducted employers' federations in the world. However, we presume that it must be our lack of an intimate knowledge of American conditions which causes us to fail to recognise the necessity for the object, apparently. No. 1 is devoted to "The Building." Here one finds set out the normal platitudes which have been reiterated *ad nauseam* ever since some person dug up the word "Rationalisation." Obviously, as foundries cater for every other industry, only a minimum number of factors are common to the whole industry.

No. 2 deals with "The Organisation," and much the same remarks apply. Organisation does not admit of a generalised treatment when pertaining to the foundry industry. No. 3 carries the caption "Getting Castings Out on Schedule"; whilst No. 4 ("Pattern Storage") is perhaps the best of the series, but the opening of the text reads like an American advertisement of the "intimate story" variety and, from the British point of view, is unnecessary. Systematic storage has long been recognised as an essential and needs no "heart-breaking" story for its emphasis to the foundry public.

In studying No. 5, we believe we found the clue for the *raison d'être* for the series. The issuing company is so large that anything it can do to have contented workers is apparently worth while. This particular booklet is on "Maintenance and Flask Storage," which if effect does tend in the direction noted—still it is rather remote! A little more information was forthcoming in No. 6, which carries the caption "Production Equipment." Here the types of sandslinger are enumerated, and some of the motions of moulding machines outlined. A vibrator for cleaning castings is sketchily described. The 7th is well worth while studying. It deals with the "Auxiliary Equipment for Saving Man Power in the Foundry"; whilst the last, No. 8, is devoted to the "Merchandising of Foundry Products." This represents the usual type of pamphlet on selling—a collection of well-known platitudes, a state of affairs always likely to exist in the treatment of this subject.

Finally, we commend the enterprise of this insurance company for trying to help the foundry industry, but whether help of this character would be welcomed in Great Britain is doubtful.

A.F.A. Honours British Foundrymen.

The American Foundrymen's Association have sent to Emeritus Professor Thomas Turner and Mr. John Shaw replicas of the Seaman and Penton Gold Medals awarded to them at the 1928 annual convention of that Association. Moreover, both these gentlemen have been created honorary life members of the Association, this being the first time that anyone has been so elected. On behalf of the British foundry industry we offer our heartiest congratulations to these two pioneers of the technical development of the trade.

The Foundry Educational Exhibit.

What may be claimed to be the first comprehensive international exhibit on Foundry Education has been staged as a part of the International Trades Exhibition. It had been felt for some time that the work being done for the education of the foundry apprentice should be made better known in order that some degree of standardisation might be effected. To this end a series of special articles have been published in THE FOUNDRY TRADE JOURNAL during the last twelve months on foundry training centres in Great Britain. The exhibit stage at the Agricultural Hall has a wider scope and covers the principal industrial countries of the world. Two of these, France and Germany, have what may be termed a national scheme, while the American Foundrymen's Association has developed a scheme which is very widely adopted in the United States.

French Methods.

Most foundrymen have heard of the French *Ecole Supérieure de Fonderie*, or Foundry High School, which was founded largely as a result of that well-known foundryman, M. E. Ronceray. It has been developed for the rapid training of foundry managers. Its students are men of 23 to 30 years of age who have already served an apprenticeship or other training in a foundry, while they must also have had a sound general education to enable them to follow the lectures. The exhibit of this School shows photographs of the lecture rooms, laboratories and equipment. An interesting foundry outlay was shown by means of drawings, these being prepared by one of the students as one of the final examinations before passing out. Each student has to prepare in detail the full working drawings, estimates and production scheme for a modern foundry. Another test for the students is to prepare from a drawing of an engine or machine part complete details for the patternmaking, moulding, size of box, venting, pouring, metal mixture and output for a given equipment. Specimen answers by some of the students are of a high order. A list showing the posts obtained by students from the School on leaving gives a good idea of the service which this School is rendering to the French foundry industry. It is interesting to note that about 15 per cent. of the students are foreigners, although there are as yet no English students.

German Enterprise.

The German section of the exhibit comes from two sources: the Foundry Institute at Aachen (Prof. E. Piwowarski) and the German Committee on Technical Teaching Methods. The former body shows a series of photographs and accounts of the methods used at the well-known Technical High School at Aachen. It is here that much research on cast iron and moulding sands has been carried out during the past few years. The latter body, known in Germany as Datsch, showed a series of some 30 charts, translated into English, which are used for the instruction of foundry apprentices. The charts are coloured sections of moulds, patterns, cores, runners, risers, etc., and in many cases show a "right" and "wrong" method, the defects caused by the "wrong" method being well illustrated. It is interesting to know that these charts are available in English at a moderate price. In addition, there were a number of small sheets with machinery parts described in German and English which serve as an illustrated technical dictionary.

The American Foundrymen's Association.

This important body showed a series of photographs of apprentice-training schemes in operation at various works. In addition the complete training scheme of the National Founders' Association was described, and blue prints were also shown of the students' competition tests. A number of Papers on foundry training which had been read before the A.F.A. were also on view.

The other foreign exhibit was a chart from the Belgian Foundrymen's Association showing the scheme for foundry training at Charleroi.

British Work.

The British exhibits in this section were most interesting, and served to show what is being done at various works and institutions in this country. Most of these schemes are not known generally, and the exhibition will have opened the eyes of many foundrymen to the good work which is in active progress. The *Sir John Cass Technical Institute* shows itself to be in possession of excellent laboratory equipment for the training of students in analysis and mechanical testing of metals, thermal analysis, dilatometry and microscopy, and for the elutriation of moulding sands and the examination and testing of coke. A course of training in foundry practice forms part of the curriculum, and it covers a wide field. When it is mentioned that Mr. Wesley Lambert has served as a lecturer on non-ferrous foundry practice it will be realised that the lectures are of a highly efficient character.

Loughborough College is well-known for the unique character of its training scheme, and the exhibit from this institution is of great interest. A large number of patterns and castings were shown, *all* of which had been made by students *for actual use*, this being the unique feature of the training scheme. The photographs and descriptions of the foundry plant show that the college is well equipped and that the course is very comprehensive. Details of this college have already been published in THE FOUNDRY TRADE JOURNAL. A number of interesting photomicrographs and radiographs are shown, all of which have been taken during the practical examination of foundry problems.

The *Leicester College of Technology* shows itself to be alive to the needs of foundry apprentices and offers a good course of lectures and practical work for all sections of the foundry trade. There are some good photomicrographs and macroprints of steel castings and rolled sections and of tinplate.

Another foundry centre which is catering for the apprentice is the *Rugby College of Technology*, and cards were shown outlining the schemes of work and methods of instruction. In addition, there were coloured drawings showing the operation of a cupola and the methods of moulding and running engineering castings.

The *Wolverhampton and Staffordshire Technical College* showed a good scheme of lectures and practical work for foundry workers and patternmakers, and appears to have a useful little foundry for this purpose.

The *Daimler Company, Limited*, show a blue print and summary of their apprentice scheme which is thoroughly practical and worthy of full study; while *W. H. Allen, Sons & Company, Limited*, of Bedford, show a most interesting display of the apprentice-training methods carried out at their works. The scheme of training is shown together with specimen lectures, lantern slides, examination papers and answers. This firm's exhibit serves to show the keenness with which some of our engineering firms are tackling the problem of foundry training and the development of a technical staff.

In addition, there is shown the training scheme for foundry students as in force at the University of Sheffield. The Institution of Mechanical Engineers show a set of Diplomas and National Certificates in Mechanical Engineering, which should serve as a guide to those who are anxious to institute similar certificates in foundry practice. The exhibit on foundry education was by no means complete, but served as a very good survey of what is being done at home and abroad. It is hoped to retain some of the data exhibited as a nucleus for a more complete collection, which will then be available for all interested in this important aspect of foundry work.

Ancient Statuary Metal.

By BASIL BARHAM.

Many writers have referred to the excellent quality of the metal used in ancient statuary work, and remarks have been made which seem to show that these writers are under the impression that, when casting small parts in non-ferrous metals, we do not achieve such good results as did the ancient Greeks and Romans. There is, however, no need to doubt our ability to do equally good work.

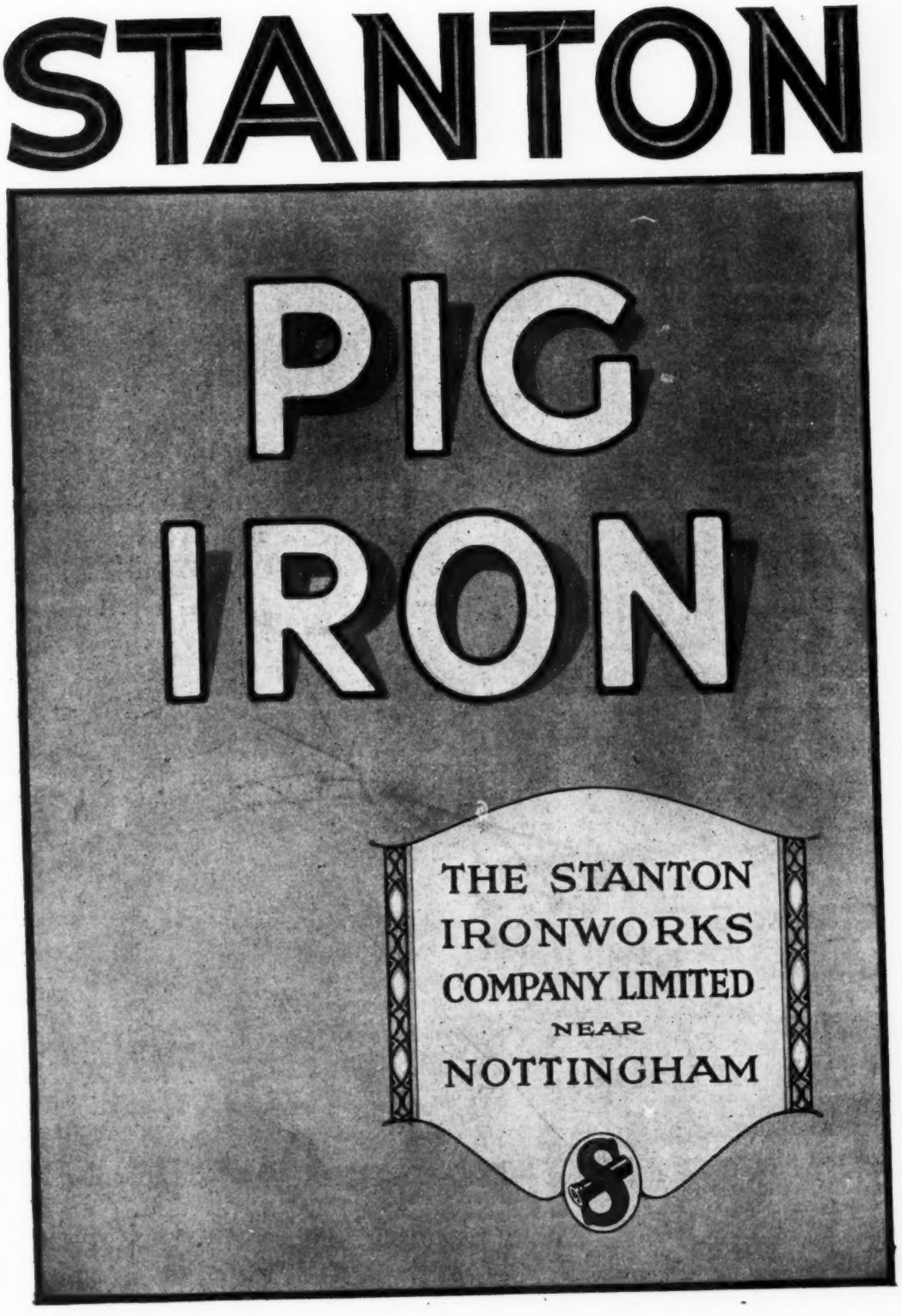
In practice, one of the chief causes of poor work, or failure when casting small parts, is pouring the metal at too high or too low a temperature. Probably in ancient foundries it was not too easy a matter to get a sufficiently high temperature, whilst such a thing as excessive heat was probably unknown. As a natural result, metal was poured at what we should regard as a medium heat, and good work resulted as a matter of course. Any bad work done in the rude foundries of Bronze Age Britain, Greece, Gaul or Rome would in the majority of cases be due to imperfect or badly fixed cores, faults in moulding, cracks, mis-runs or run-outs, and breakages in handling. We have just the same causes of failure in our modern foundries, and, in addition, have a tendency to pour at too high a heat.

We can pour at what viscosity we please, we can design and make our moulds as perfectly as possible, we can guard against fractures during cooling, with the occlusion of gases, and employ chemists and metallurgists to decide upon the mix. It is not only absurd, therefore, but actually savours of prejudice, for writers to affirm that there is some "lost art" which prevents us from equalling the work of some Cretan, Arabian, Celtic, Latin or Grecian metal-worker of the first century.

The position is just the same when we deal with the magnificent work of the Middle Ages; the exquisite products of Italian, French, Spanish and Moorish craftsmen. With regard to these masterpieces, the metal casting itself played a very minor part, and any foundry apprentice in his last year should be able to equal if not excel the work even of Cellini in that respect. What is lacking in our modern work, that which was an essential part of the work to which we are referring, is the Spirit of Craftsmanship. It is that which we cannot equal; that which we cannot even begin to equal. So far as the rough-and-ready side, the bread-and-butter side, of the work is concerned, matters are satisfactory. We can carry on with that in the teeth of any and every competition.

We cannot equal the work of the Renaissance so far as artistic spirit is concerned; we cannot even murder as artistically as the Borgias and the Medicis, but we can cast aluminium motor mascots by the million, each exactly alike and each requiring a minimum of finish before being ready for market. And that is something the great Benvenuto Cellini himself could not have accomplished.

National Physical Laboratory.—On June 18 the annual inspection by the General Board of the National Physical Laboratory took place. Visitors were received in the main Aerodynamics Building by Sir Ernest Rutherford, O.M. (President of the Royal Society, Chairman of the Board), Sir Richard Glazebrook, K.C.B., F.R.S. (Chairman of the Executive Committee), and Sir Joseph E. Petavel, K.B.E., D.Sc., F.R.S. (Director of the Laboratory). The range of the experimental work carried on by the Laboratory staff is indicated by the 215 different investigations in progress, briefly outlined in the programme provided for the use of the visitors.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NEAR
NOTTINGHAM

Trade Talk.

SCOTTS' SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, have launched the destroyer "Ardent," which they have built for the British Admiralty.

VIOZONE, LIMITED, have removed from 19, Cursitor Street, London, E.C.4, to 88, 89 and 90, Chancery Lane, W.C.2. The telephone number is Holborn 6331.

MESSRS. VICKERS-ARMSTRONGS, LIMITED, Barrow-in-Furness, have received an order for the new turbine machinery for the Chilean battleship "Almirante Latorre."

THE LONDON AND NORTH EASTERN RAILWAY COMPANY has placed a contract with the Metropolitan-Cammell Carriage, Wagon and Finance Company, Limited, for 230 steel containers.

THE FINAL RESULT of the Liverpool metal trade golf competition is announced. Mr. R. F. Lowe won the challenge cup with memento, Mr. G. H. Williams taking the second prize.

MESSRS. LITHGOW, LIMITED, Port Glasgow, have launched the screw steamer "Gryfevale," which they have built to the order of Messrs. Andrew Crawford & Company, Limited, Glasgow.

MR. A. C. TURNER, the London agent of General Refractories, Limited, Sheffield, announces that the London office of the company has been removed from 92, Cannon Street, to 20, Budge Row, E.C.4.

A SMART DISCHARGE of pig-iron was effected at Grangemouth Docks recently, when the steamer "Skinningrove," from Middlesbrough, was discharged of 575 tons in just under two and a-half hours.

THE SYDNEY (N.S.W.) CIVIC COMMISSIONERS have accepted the tender of Messrs. Siemens of Australia, Limited, for the supply of 145,900 yds. of 30,000-volt cable, and pilot cable and jointing material, at a cost of £266,083.

THE AILSA SHIPBUILDING COMPANY, LIMITED, Troon, have contracted with Messrs. J. Hay & Sons, Limited, Glasgow, for the construction of a steamer for their coasting trade. The builders will also supply triple-expansion engines.

ACCORDING TO the annual report of the National Union of Iron Workers, unemployment amongst the members of the Society has decreased from 11.26 per cent. at the end of December, 1928, to 8.37 per cent. at the end of March, 1929.

RUMOURS THAT the Millom and Askam Hematite Iron Company, Limited, was to become merged in a new combine are officially denied. Mr. G. Mure Ritchie, the chairman, states that the future of the company seems to be assured, and no negotiations for a merger with other concerns have been or are going on.

THE DEPARTMENT OF OVERSEAS TRADE has issued application forms to manufacturers for space in the London section of the 1930 British Industries Fair, which is to be held from February 17 to 28 at Olympia. A letter accompanying the forms states that space will only be guaranteed to firms whose applications are received by July 20.

MESSRS. BRUCE PEEBLES & COMPANY, LIMITED, Edinburgh, have appointed Mr. George E. Whitehead, of 102, St. Mary Street, Cardiff, as their representative for South Wales and the counties of Gloucester, Somerset, Devon and Cornwall. All arrangements have been made with regard to service in connection with existing plant, installations, etc.

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, are completing at their Walker shipyard another interesting locomotive-carrying vessel, the "Belnor," for Norwegian owners. A feature of the vessel is a 100-ton crane with which she is fitted. In a successful test made on the "Belnor" the crane lifted a load of 110 tons of pig-iron from the jetty to the main hatchway of the ship.

THE WEST OF SCOTLAND COMMITTEE of the Boilermakers' Society report that trade has been fairly good in the shipyards on the lower reaches of the Clyde during the past month. It is stated that the improvement in trade is likely to continue for some time. Several orders for new vessels have been booked by local firms. Repair work has fallen off in the shipyards, while there has also been a decline in the boiler shops.

THE TWIN-SCREW STEAMER "Goschen," built for the South Indian Railway Company by Messrs. D. & W. Henderson & Company, Limited, Partick, Glasgow, has been launched. The vessel, which is intended for passenger and cargo service between the Island of Rameswaren and Talaimanaar, in Ceylon, is 250 ft. long and of a gross tonnage of 950. The propelling machinery consists of two geared turbines and water-tube boilers by Messrs. Yarrow & Company, Limited, Scotstoun.

AFTER HAVING been re-cast and re-hung, the peal of eight bells at the parish church at Hatherleigh, Devon, were dedicated by the Bishop of Exeter on June 24. The work, which was carried out by Messrs. Mears & Stainbank, of the Whitechapel Bell Foundry, London, under the supervision of the principal of the firm, Mr. A. A. Hughes, cost over £1,000. The oak framework and beams have been replaced by steel girders, the bells have been fitted with ball bearings and the ringing chamber been restored to its original position halfway up the tower.

THE REPORT of the Royal Metal Trades Pension and Benevolent Society for the years 1926-28 has just been published. During the past year £7,007 was distributed to annuitants, temporary assistance from the Benevolent Fund was given to the extent of £225, and 308 persons were recipients of the Society's benefits, 279 as pensioners and 29 who were temporarily relieved. The income from renewed annual subscriptions shows an improvement, which the board venture to hope indicates steady progress, with the promise of a fuller development in the future.

THE PATENTS COMMITTEE, under the chairmanship of the Rt. Hon. Sir Charles Sargent, have begun their investigations, and persons and associations who wish to submit suggestions or to give evidence before the Committee are invited to communicate with the secretary, Mr. R. W. Luce, Industrial Property Department, Board of Trade, 25, Southampton Buildings, W.C.2. The Committee were appointed by the Board of Trade to report whether any amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office, are desirable.

MR. MACDONNELL, Montreal manager of the National Trust Company, who was appointed receiver and manager of the Dominion Iron and Steel Company in July, 1926, by the Supreme Court of Nova Scotia, was due to arrive in London last week. Mr. Macdonnell is bringing with him drafts of the various documents in connection with the proposed termination of receivership and the basis to be recommended to the holders of the consolidated bonds of the company, which he will submit to the committee in London representing the sterling series of the consolidated bonds. This committee has already approved the general features of the proposed basis. The basis to be submitted to the consolidated bondholders will provide that they shall give an extension of time for the payment of the interest in arrears on the consolidated bonds, represented by the coupon which became due on September 1, 1926, and subsequent matured coupons.

Obituary.

WHILE GEORGE MELLON, a crane swinger, who resided at Chapel Street, Airdrie, was engaged recently in the Union Tube Works, Coatbridge, removing tubes by means of an overhead electric crane, he was struck by a tube which slipped out of the sling and was killed instantly.

MR. CHRISTOPHER MOODY, general manager of the Britannia and Newport works of Messrs. Dorman, Long & Company, Limited, Middlesbrough, died recently at Whitby. Mr. Moody, who was in his 61st year, first joined the staff of Messrs. Dorman, Long & Company as a draughtsman 40 years ago. He was a former President of the Iron and Steel Trades Employers' Association.

MR. C. F. BRUSH, a pioneer in the development of electric lighting, has died at Cleveland, Ohio, at the age of 80. Mr. Brush was the inventor of the Brush electric arc light, and in 1880 founded the Brush Electric Company, which introduced the invention to the United States, England and Europe. Its fundamental principles have been embodied in many later systems. Mr. Brush was awarded the Edison Medal in 1913.

MR. H. J. S. MACKAY, managing director of the Stirling Boiler Company, Limited, London, died after a short illness on Wednesday, June 19. Mr. Mackay, who was 57 years of age, was apprenticed in 1889 with Messrs. A. Chaplin & Company, Limited, of Govan, and afterwards obtained drawing-office and engine-shop experience with Messrs. D. & W. Henderson & Company, Limited, Glasgow. Subsequently he spent some four years as a sea-going engineer. Mr. Mackay joined the Stirling Boiler Company, Limited, in 1902, his successive positions being engineer, London manager, general manager, and, finally, managing director. He was a member of the Institution of Mechanical Engineers and the Institute of Marine Engineers, and an Associate of the Institution of Naval Architects.

Personal.

MR. A. G. WATSON has recently been appointed chief mechanical engineer to the South African Railways and Harbours.

MR. W. RAWLINSON, a director of Messrs. J. W. Jackman & Company, Limited, of London and Manchester, is shortly sailing to the United States of America to ascertain first hand the latest developments in American foundry practice.

Wills.

M'KAY, ALEX., iron merchant, Glasgow ... £3,457

HUNTER, ADAM, marine engineer, Ardrossan £4,339

YOUNG, J. A., of Gateshead, wire-rope manufacturer £13,554

GOLDTHORPE, E., works manager of Messrs. Butterworth & Dickinson, Limited, Globe Ironworks, Burnley ... £1,946

HOLMAN, F., of Messrs. N. Holman & Sons, Limited, engineers and iron-founders, Penzance £15,037

MASON, J. F., of Eynsham Hall, Witney, Oxon, and of Bruton Street, W., director of Dorman, Long & Company, Limited, steel manufacturers and merchants, and formerly of the North-Eastern Steel Company, Limited (now merged in Messrs. Dorman, Long & Company, Limited) £1,065,589

Reports and Dividends.

Minerals Separation, Limited.—Final dividend for 1928 of 20 per cent., less tax, making 25 per cent. for the year.

Ambrose Shardlow & Company, Limited.—Trading profit of £11,629, reducing the debit on profit and loss account to £4,805.

Davy Bros., Limited.—Loss for year, £6,307; debit balance brought in, £42,302; debit balance carried forward, £48,610.

Greenwood & Batley, Limited.—Net profit, £22,385; dividend of 5 per cent. on the ordinary shares; carried forward, £11,397.

Baker, Perkins, Limited.—Net profit, £91,732; pension fund, £5,000; to obsolescence reserve, £10,000; to general reserve, £10,000; final dividend of 3 per cent. on the ordinary shares, making 7 per cent. for the year.

General Electric Company, Limited.—Profit, £1,084,077; brought in, £338,456; debenture stock interest, £222,380; depreciation, £206,055; contribution to pension fund, £24,661; preference dividends, £252,000; to reserve, £130,000; dividend of 10 per cent. on the ordinary shares, £225,364; carried forward, £362,071.

New Companies.

"Poro" Metals, Limited, 130, Queen Victoria Street, London, E.C.—Capital £100. Directors: R. R. Reynolds and H. J. Skingle.

Maybrey Light Metals Company, Limited.—Capital £2,000. Managing director: H. J. Maybrey, 22A, Gloucester Road, London, S.W.

Northern Chromium Company, Limited, Skinnerburn Road, Newcastle.—Capital £5,000. Directors: G. M. Carter, A. M. McCracken, F. Nicholson and A. Grieve.

Gardner Denver Company, Limited, 56, Kingsway, London, W.C.—Capital £5,000. Machinery merchants, etc. Directors: D. M. Armstead and R. C. W. Burn.

G. & J. Hall, Limited, Hereford Street Works, Sheffield.—Capital £35,000. Tool manufacturers, etc. Directors: Mrs. L. Hall, Mrs. C. A. Hall, P. B. Coward and J. H. Pickford.

Steel Industries of Great Britain, Limited.—Capital £11,000,000, to acquire and hold the whole or any portion of the shares, debentures, debenture stock and other interests in the United Steel Companies, Limited, and the United Strip and Bar Mills, Limited, to adopt an agreement with the Austin Friars Trust, Limited, and to carry on the business of steel and iron manufacturers, colliery proprietors, etc. Solicitors: Messrs. Simmons & Simmons, 1, Threadneedle Street, London, E.C.2.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron trade, as at present existing, continue unsatisfactory from the consumers' point of view, and it is regretfully to be admitted that, so far, no improvement in the scale of production, the only apparent remedy for the present stagnation of business, is yet in sight. Production of commercial grades of Cleveland foundry iron remains practically unchanged, and as there has been a big increase in consumption, the shortage becomes more and more pronounced as the weeks pass by. It is now nearly two months since the Cleveland ironmasters intimated that they would have no more iron to sell until October. The announcement was not taken seriously in some quarters, but there is the fact that the producers still decline to accept any more business. Tees-side ironmasters are consequently maintaining an attitude of caution, and in the circumstances many local consumers are buying extensively in the Midland markets. Meanwhile, the export of Cleveland iron has almost ceased, and only small sales are possible to local consumers at the following figures:—No. 1 Cleveland foundry iron, 76s.; No. 3 G.M.B., 73s. 6d.; No. 4 foundry, 72s. 6d.; No. 4 forge, 72s. per ton.

Business in the market for East Coast hematite continues active, and all the works have healthy order books; but producers are anxious not to curtail the export trade by forcing up prices. On the other hand, they have to meet increasing costs, and thus a firmness of prices has to be recorded, 74s. 6d. per ton for mixed numbers and 75s. for No. 1 quality now being regarded as minimum figures. On the North-West Coast, Bessemer mixed numbers are again quoted at 75s. per ton at works, with 6d. per ton extra for No. 1 quality.

LANCASHIRE.—Local markets for foundry pig are reported fairly active, with prices inclined to stiffen, especially for business on forward account, sellers asking a premium of 2s. 6d. per ton for September delivery. Current quotations rule as follow:—Staffordshire No. 3, 73s.; Derbyshire, 72s.; with Scottish brands at 86s. 6d. to 87s., all per ton delivered locally.

THE MIDLANDS.—Demand for foundry pig for current consumption in this area is again on an increasing scale, not so much on account of current consumption, but as a precaution against an anticipated advance in prices in the near future. The demand, in fact, has been so insistent of late that several of the furnaces have closed their books and will not take any further tonnage. Current quotations now rule as follow:—73s. 6d. for Derbyshire No. 3, 74s. 6d. for North Staffordshire No. 3, and 70s. for Northants No. 3, delivered local stations.

SCOTLAND.—Business in the Scotch pig-iron market continues exceedingly quiet. While deliveries of steel-making irons are fairly good, foundry pig-iron is in very poor demand, and most consumers complain that business has become much quieter in recent weeks. At the same time, the price of No. 3 Scotch foundry iron remains firm at the official minimum of 74s. 6d. per ton at the furnaces.

Finished Iron.

At Birmingham this week, while the makers of Staffordshire marked bars continue to be fairly well occupied, there has been a further falling away of business for crown bars. The makers had hoped that the improvement which set in a few weeks back would be maintained, but this has not proved to be the case, and specifications are very difficult to get. Very little support is being given by the nut and bolt makers to the local works for bolt iron, the bulk of their requirements of this nature coming from Belgium and France. The price for crown quality continues to vary to a considerable extent; good brands would cost £10 to £10 5s., but others are offered at between £9 10s. and £10. Marked bars are quoted at £12, and nut and bolt iron at £9 to £9 5s.

Steel.

Business at Sheffield is again reported quiet, with basic billets still the most active feature of the steel market. Siemens acid billets are very dull. Wire rods sell with a fair amount of freedom, but there appears to be more Continental competition than of late. Quotations are:—Billets: Siemens acid, £9 10s.; soft basic, £7; semi-hard, £7 12s. 6d.; medium, £8 2s. 6d.; hard, £9 2s. 6d. to £9 12s. 6d. Wire rods: Acid, £12 5s. to £12 10s.; soft basic, £8 10s.; medium hard, £9 10s. to £10; hard, £10 15s. In the tinplate market there is only a slow demand, with current quotations as follow:—Coke tinplates, 18s. 1½d. to 18s. 3d., basis, net cash, f.o.b. Wales.

Scrap.

Notwithstanding a continued expansion of demand for pig-iron, it is somewhat curious to record that demand for foundry scrap remains quiet in most markets for this class of material, with few variations in prices during the week current. An exception may, however, be noted on the North-East Coast, where there has been a rise of 1s. per ton in the price of heavy cast iron. For ordinary qualities the foundries are now prepared to pay 66s., and machinery quality in handy sizes has realised up to 68s. 6d. per ton delivered. In the Midlands the demand for heavy cast-iron scrap has been well maintained, 70s. to 72s. 6d. being quoted for heavy qualities and 57s. 6d. to 60s. for light cast-iron scrap. In Scotland the cast-iron scrap market is dull; even machinery at 70s. per ton is not in demand, and the outlets for ordinary cast-iron scrap are very limited, so that the price has dropped to around 60s. to 62s. 6d. Old cast-iron railway chairs are at 66s., with few buyers. Light cast-iron scrap is also easy at 59s. to 60s., with firebars at 57s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Some weakening in the position of warrant copper during the past week was to be attributed to speculative influences, and it is now apparent that the controlling export interests will find difficulty in maintaining present high value levels. The statistical outlook is also somewhat obscure, refinery stocks having increased heavily to over 70,000 tons in May, and under the influence of decreasing deliveries these stocks are expected to show further material increase in the next few months.

Closing quotations are:—

Cash.—Thursday, £73 10s. to £73 11s. 3d.; Friday, £73 to £73 2s. 6d.; Monday, £73 10s. to £73 12s. 6d.; Tuesday, £73 7s. 6d. to £73 10s.; Wednesday, £72 17s. 6d. to £73.

Three Months.—Thursday, £73 2s. 6d. to £73 3s. 9d.; Friday, £72 17s. 6d. to £72 18s. 9d.; Monday, £73 5s. to £73 7s. 6d.; Tuesday, £73 to £73 2s. 6d.; Wednesday, £72 18s. 9d. to £73 1s. 3d.

Tin.—Fluctuations in standard tin values of late have been only moderate in range, and on the whole markets may be reported steady. The market awaits with keen expectancy the issue of the June statistics, which it is confidently anticipated will disclose a substantial decrease in visible supplies. Consumption is remarkably well sustained at home and abroad, and, with the powerful group influence exerted in support of markets, values should present firmer levels, with an advancing tendency in the immediate future.

Official closing prices:—

Cash.—Thursday, £201 to £201 2s. 6d.; Friday, £201 10s. to £201 15s.; Monday, £202 to £202 5s.; Tuesday, £201 15s. to £202; Wednesday, £204 to £204 2s. 6d.

Three Months.—Thursday, £204 5s. to £204 10s.; Friday, £204 15s. to £204 17s. 6d.; Monday, £205 2s. 6d. to £205 5s.; Tuesday, £205 to £205 2s. 6d.; Wednesday, £207 to £207 5s.

Spelter.—There has been a little more inquiry of late, but the market generally is experiencing a period of seasonal slackness, and sufficient metal has been on offer from the Continent to enable consumers to cover their requirements without disturbing the market.

Daily quotations are:—

Ordinary.—Thursday, £26 3s. 9d.; Friday, £25 13s. 9d.; Monday, £25 6s. 3d.; Tuesday, £25 8s. 9d.; Wednesday, £25 8s. 9d.

Lead.—Consumptive demand for soft foreign pig is quiet, and the position of supply and demand appears to be very evenly balanced, so that in the present circumstances no great variation from current level of values is to be looked for.

Prices have been:—

Soft Foreign Prompt.—Thursday, £23 12s. 6d.; Friday, £23 7s. 6d.; Monday, £23 7s. 6d.; Tuesday, £23 7s. 6d.; Wednesday, £23 2s. 6d.

Big Output for Half-Year from Clyde Shipyards.

Output from the Clyde shipyards continues at a high level, and there has been an extra spurt during June in view of the approach of the Fair holidays. The aggregate tonnage of the vessels launched during the month is 47,783—the second highest output for the year so far. The March figure was 75,500 tons, but this was exceptional, and the June total, though much smaller than that for March, is rather above the average. The June output represents an unusually wide distribution of work. There was only one large vessel, the twin-screw motor-ship "Western Prince," of 11,000 tons, built by Messrs. Napier & Miller, Old Kilpatrick, for the Prince Line. The next in point of size was just over 5,000 tons, and the substantial total for the month was composed for the rest of small steamers, the destroyer "Ardent," built by Messrs. Scotts, Greenock, coasting steamers, dredgers, barges and a large variety of yachts and motor cruisers.

For the half-year the total output is 284,558 tons, which compares with 302,903 for the corresponding six months of last year, 302,957 tons in 1925 (the previous highest since the war), 145,171 in 1927, and 348,476 in 1913 (the record year).

It will be seen, therefore, that 1929 compares very favourably with the best of past years so far. The fly in the ointment is the serious doubt as to how long the comparatively high rate of production can continue, for in recent months the number of contracts announced has been far short of balancing output. It is feared that after the Fair holidays there will be a lessening in the amount of employment available in the yards, for big inroads have been made upon the substantial amount of work which was on hand early in the year. June has shown little improvement in the matter of new work. The contracts reported during the month are as follow:—Scotts' Shipbuilding & Engineering Company, Limited, Greenock, a twin-screw passenger and cargo motor-ship for the Holt Line; Blythswood Shipbuilding Company, Limited, Scotstoun, a single-screw passenger and cargo steamer for the Union Steamship Company, New Zealand; Barclay, Curle & Company, Limited, Scotstoun, a motor cargo vessel of 13,500 tons (deadweight) for Norwegian owners; Lithgows, Limited, Port Glasgow, two motor tankers for the United Molasses Company, London; and Beardmore & Company, Limited, Dalmuir, a twin-screw motor-propelled yacht of 750 tons.

Pulverised Fuel.

Messrs. Yarrow & Company, Limited, Scotstoun, Glasgow, as the result of an exhaustive series of experiments and trials, have developed a form of burner and pre-furnace for use with pulverised fuel which has proved to be very successful with both water-tube and cylindrical boilers. Messrs. Yarrow & Company have come to an arrangement with Messrs. P. Henderson & Company, shipowners, of Glasgow, to equip half the boilers of the "Amarapoora" with their system of pulverised-fuel burning. The pulverisers will be of the Atritor type manufactured by Messrs. Alfred Herbert & Company, Limited, Coventry. It is hoped that a reliable set of results showing the merits of pulverised fuel may be obtained. The "Amarapoora" is a passenger and cargo steamer of 8,000 tons plying between Burma and Great Britain.

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WHITE DUST,
COAL DUST.

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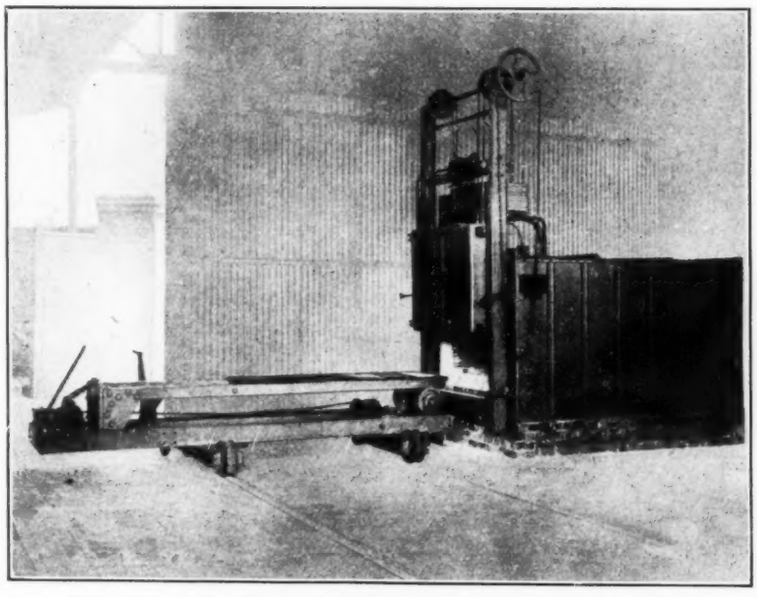

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Melting, Refining and Core-drying.

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HEROULT or AJAX-NORTHRUP — For melting steel and high-grade grey iron.
NOTE:—The AJAX-NORTHRUP Furnace has proved its superiority in the production of intricate alloy steel castings.
AJAX-WYATT—for melting brass and nickel-silver.
"EFCO" RESISTANCE—for annealing, etc.

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COPPER.

	£	s.	d.
Standard cash	72	17	6
Three months	72	18	9
Electrolytic	84	10	0
Tough	75	10	0
Best selected	75	10	0
Sheets	110	0	0
India	93	0	0
Wire bars	84	10	0
Do. July	84	10	0
Do. Aug.	84	10	0
Ingot bars	84	10	0
H.C. wire rods	86	15	0
Off. av. cash, June	74	7	9
Do. 3 mths., June	73	19	3⅜
Do., Sttlmnt., June	74	8	0
Do., Electro, June	84	7	0
Do., B.S., June	77	8	1½
Aver. spot price, copper, June	74	7	9
Do. wire bars, June	84	13	9
Solid drawn tubes			15½d.
Brazed tubes			15½d.
Wire			12½d.

BRASS.

Solid drawn tubes	13d.
Brazed tubes	15d.
Rods, drawn	12½d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	11⅝d.
Wire	11½d.
Rolled metal	10⅝d.
Yellow metal rods	8½d.
Do. 4 × 4 Squares	9d.
Do. 4 × 3 Sheets	9½d.

TIN.

	£	s.	d.
Standard cash	204	0	0
Three months	207	0	0
English	204	10	0
Bars	204	5	0
Straits	205	10	0
Australian	204	0	0
Eastern	207	10	0
Banca	211	15	0
Off. av. cash, June	200	5	9⅜
Do., 3 mths., June	203	9	6
Do., Sttlmt., June	200	5	4½
Aver. spot, June	200	5	9¼

SPELTER.

	£	s.	d.
Ordinary	25	8	9
Remelted	23	10	0
Hard	21	0	0
Electro 99.9	27	15	0
English	25	17	6
India	22	15	0
Zinc dust	(Nom.) 34	10	0
Zinc ashes	8	15	0
Off. aver., June	26	2	0
Aver., spot, June	26	4	3¾

LEAD.

	£	s.	d.
Soft foreign ppt.	23	2	6
English	24	10	0
Off. average, June	23	12	11⅝
Average spot, June	23	13	10¼

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	35	0	0
Do. V.M. ex whf.	33	7	6
Rods	42	0	0
Boiler plates	31	0	0
Battery plates	32	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	50	5	0
Chinese	33	17	6
Crude	Nominal		

QUICKSILVER.

	£	s.	d.
Quicksilver	22	2	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	15	0
45/50%	12	0	0
75%	19	10	0
Ferro-vanadium—			
35/50%	12/10 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/- lb. Mo.		
Ferro-titanium—			
23/25% carbonless	11d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	2/9 lb.		
Tungsten metal powder—			
98/99%	3/- lb.		
Ferro-chrome—			
2/4% car.	£32	10	0
4/6% car.	£23	15	0
6/8% car.	£23	0	0
8/10% car.	£22	15	0
Ferro-chrome—			
Max. 2% car.	£33	15	0
Max. 1% car.	£37	12	6
Max. 0·70% car.	£41	12	6
70% carbonless	1/2 lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/4 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/6 lb.		
Ferro-manganese (net)—			
76/80% loose	£13	15	0
76/80% packed	£14	15	0
76/80% export	£14	10	0
Metallic manganese—			
94/96%, carbonless	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finshed bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length, 10% extra	

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				3	17	0
Bundled steel and shrngs.	3	14	0 to	3	16	0
Mixed iron and steel	3	10	0 to	3	11	6
Heavy cast iron	3	2	6 to	3	5	0
Good machinery for foundries				3	7	6
Cleveland—						
Heavy steel				3	5	0
Steel turnings				2	17	6
Cast iron borings				2	17	6
Heavy forge				3	17	6
W.I. piling scrap				3	12	6
Cast-iron scrap	3	6	0 to	3	8	6
Lancashire—						
Cast-iron scrap	3	0	0 to	3	10	0
Hvy. wrought				3	12	6
Steel turnings				2	17	6
Scotland—						
Heavy steel				3	15	0
Cast-iron borings				2	14	6
Wrought-iron piling				3	12	6
Heavy machinery				3	10	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	62	0	0
Brass	41	0	0
Lead (less usual draft)	20	10	0
Tea lead	17	0	0
Zinc	16	10	0
New aluminium cuttings	67	0	0
Braziery copper	54	0	0
Gunmetal	53	0	0
Hollow pewter	140	0	0
Shaped black pewter	105	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	76/-
Foundry No. 3	73/6
Foundry No. 4	72/6
Forge No. 4	72/-
Hematite No. 1	75/-
Hematite M/Nos.	74/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	85/-
„ d/d Birm.	91/-
Midlands—	
Staffs. common*	—
„ No. 4 forge*	70/6
„ No. 3 fdry*	74/6
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	66/-
„ fdry. No. 3*	70/-
Derbyshire forge*	69/6
„ fdry. No. 3*	73/6
„ basic*	—

* d/d Black Country dist.

Scotland—	
Foundry No. 1	77/-
„ No. 3	74/6
Hem. M/Nos.	78/-
Sheffield (d/d district)—	
Derby forge	64/6
„ fdry. No. 3	68/6
Lincs. forge	—
„ fdry. No. 3	72/6
E.C. hematite	86/-
W.C. hematite	87/-
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
„ fdry. No. 3	72/-
Northants foundry No. 3	—
Dalzell, No 3 (special)	102/6 to 105/-
Summerlee, No. 3	92/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	92/-
Monkland, No. 3	92/-
Shotts, No. 3	92/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.				10	15	0
Nut and bolt iron	9	0	0 to	9	5	0
Hoops	11	0	0 to	11	10	0
Marked bars (Staffs.) f.o.t.				12	0	0
Gas strip	11	0	0 to	11	10	0
Bolts and nuts, ¾ in. × 4 in.				15	5	0
Steel—						
Ship plates	8	12	6 to	8	17	6
Boiler plts.				10	10	0
Chequer plts.				10	12	6
Angles				8	2	6
Tees				9	2	6
Joists				8	2	6
Rounds and squares, 3 in. to 5½ in.				9	2	6
Rounds under 3 in. to ¾ in. (Untested)				8	0	0
				and upwards		
Flats, over 5 in. wide and up				8	7	6
Flats, 5 in. to 1½ in.				7	17	6
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs.)	10	0	0 to	10	10	0
Black sheets, 24g.	10	5	0 to	10	10	0
Galv.cor.shts., 24g.	13	2	6 to	13	15	0
Galv. fencing wire 8g. plain				12	0	0
Billets, soft	6	10	0 to	7	0	0
Billets, hard	7	12	6 to	8	2	6
Sheet bars	6	5	0 to	6	10	0
Tin bars	6	5	0 to	6	10	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6½
Rods	1/5
Tubes	1/9
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.76
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	15.00
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.95
Tank plates	1.95
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.60
Sheets, blue an'l'd, No. 13	2.35
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.30
Tinplates, 100 lb. box	$5.35

COKE (at ovens).

Welsh foundry	25/- to 30/-
„ furnace	22/- to 25/-
Durham and North.	
„ foundry	17/6 to 19/6
„ furnace	18/6
Midlands, foundry	—
„ furnace	19/- and up

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box		18/1½
„	28×20 „		36/6
„	20×10 „		26/3
„	18¾×14 „		18/9
C.W.	20×14 „		15/3
„	28×20 „		33/6
„	20×10 „		21/3
„	18¾×14 „		16/-
Terneplates	28×20		33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	10	0
Bars, hammered, basis	£17	10	0 to	£18	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	15	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£20	0	0 to	£24	0	0
Bars and rods, dead soft, steel	£10	0	0 to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas ..	.. 67½% ..	.. 50%
Water ..	.. 63½% ..	.. 45%
Steam ..	.. 60% ..	.. 40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
June 27 ..	73	10	0	dec.	8/9
„ 28 ..	73	0	0	„	10/–
July 1 ..	73	10	0	inc.	10/–
„ 2 ..	73	7	6	dec.	2/6
„ 3 ..	72	17	6	„	10/–

Electrolytic Copper.

	£	s.	d.			
June 27 ..	83	15	0	No	change	
„ 28 ..	83	15	0	„	„	
July 1 ..	84	0	0	inc.	5/–	
„ 2 ..	84	10	0	„	10/–	
„ 3 ..	84	10	0	No	change	

Standard Tin (cash).

	£	s.	d.		
June 27 ..	201	0	0	inc.	2/6
„ 28 ..	201	10	0	„	10/–
July 1 ..	202	0	0	„	10/–
„ 2 ..	201	15	0	dec.	5/–
„ 3 ..	204	0	0	inc.	45/–

Tin (English ingots).

	£	s.	d.			
June 27 ..	201	10	0	dec.	5/–	
„ 28 ..	202	0	0	inc.	10/–	
July 1 ..	202	15	0	„	15/–	
„ 2 ..	202	5	0	dec.	10/–	
„ 3 ..	204	10	0	inc.	45/–	

Zinc Sheets (English).

	£	s.	d.			
June 27 ..	35	0	0	No	change	
„ 28 ..	35	0	0	„	„	
July 1 ..	35	0	0	„	„	
„ 2 ..	35	0	0	„	„	
„ 3 ..	35	0	0	„	„	

Spelter (ordinary).

	£	s.	d.			
June 27 ..	26	3	9	No	change	
„ 28 ..	25	13	9	dec.	10/–	
July 1 ..	25	6	3	„	7/6	
„ 2 ..	25	8	9	inc.	2/6	
„ 3 ..	25	8	9	No	change	

Lead (English).

	£	s.	d.		
June 27 ..	25	0	0	dec.	5/–
„ 28 ..	24	15	0	„	5/–
July 1 ..	24	15	0	No	change
„ 2 ..	24	15	0	„	„
„ 3 ..	24	10	0	dec.	5/–

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1890	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 14 3	0 14 3	0 15 7½	0 15 7½	0 15 7½	0 15 2¾
1891	0 15 7½	0 14 2½	0 14 2½	0 14 2½	0 13 6¾	0 13 6	0 13 3¾	0 13 0	0 12 11	0 13 0	0 13 7	0 13 1	0 14 9¼
1892	0 13 1	0 12 9	0 12 9	0 12 9	0 11 10½	0 12 1	0 12 1	0 12 2	0 12 2	0 12 0	0 12 0	0 11 11	0 12 4½
1893	0 11 11	0 11 5½	0 11 10	0 11 10	0 12 1½	0 12 3	0 12 1½	0 12 3	0 12 1	0 12 4	0 12 4½	0 12 6	0 12 0¾
1894	0 12 6	0 12 6	0 12 7½	0 12 1¾	0 12 4	0 12 1	0 12 0	0 12 0½	0 11 10½	0 12 2	0 12 0	0 12 0	0 12 1¾
1895	0 12 0	0 12 0	0 11 10	0 12 0	0 12 0	0 12 3	0 12 3	0 12 4	0 12 4	0 12 6	0 12 7	0 12 6	0 12 2¾
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 8
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8½
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8½
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 15 6	0 14 9	0 14 9	0 15 1	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9¾
1905	0 15 3	0 15 6	9 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 3¾
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2¾
1908	0 16 6	0 15 0	0 15 6	0 15 6	0 15 3	0 15 0	0 15 0	0 14 9	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5¼
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 0	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6½	1 1 3	1 1 5	1 0 9¾
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0½	1 1 6½	1 0 7½
1912	1 2 3	1 2 6	1 2 6	1 1 1½	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2½
1913	1 2 9	1 2 2	1 1 7½	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5½
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1½	0 19 7½	0 18 11½	0 17 10½	0 18 7½	1 1 0½	0 18 5¼
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1½
1916	1 18 6	2 0 1½	2 2 6½	2 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price Fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 13 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 15 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 0	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 13 8¾
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9½	1 4 2½	1 3 3½	1 2 6	1 2 3	1 5 2½
1923	1 2 9½	1 4 6½	1 5 2	1 4 8½	1 4 6	1 4 6	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10½
1924	1 4 2½	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1½
1926	1 1 1½	1 1 6	1 1 6	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 6*	1 1 0*	1 1 6*	1 1 6*	*	1 1 4½
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 7½	1 1 0	1 1 0	1 1 6*	1 1 0	1 1 0	1 1 7½
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 2¾
1929	1 2 6	1 2 6¾	1 2 11½	1 3 0	1 3 0	1 3 2½		—	—	—	—	—	—

* Prices nominal.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY MANAGER or FOREMAN; position desired; practical, technical, and metallurgical knowledge; general and high-class work; 17 years' experience as foreman; good references; moderate salary accepted; M.I.B.F. —Box 246, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BRASSFOUNDRY SUPERINTENDENT. First-class man desires a Change. Accustomed to High-class Work, Engine, Pump, Compressor, Electrical, High-pressure Valve and General Castings in Brass, Bronzes, Aluminium and Special Alloys. Expert knowledge of Mixing, Melting and Temperatures.—Box 252, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WOOLWICH POLYTECHNIC, S.E.18.

WANTED, for September, a full-time Instructor in Patternmaking and Foundry Work. Salary, according to the scale, £290 by £14 to £410, commencing according to previous experience.—Further particulars and form of application from THE PRINCIPAL.

AGENCY.

COMMERCIAL (late Foundry Manager) desires additional lines; Midlands; foundries and engineers agent, Aurora Lamp outfit; free demonstrations.—Box 260, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of SHOPPING,
Compact and Convenient.

SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

A TRAFFORD PARK BARGAIN.—Modern Foundry with own railway sidings, excellent warehouse, packing room and fine offices, centrally heated, for SALE. Premises are all one storey and easily adaptable for other trades. Cost £20,000 in 1921. For a quick sale, owners will take £2,000, including two 4-ft. modern cupolas.—F. S. AIREY, ENTWISTLE & COMPANY, 10, Norfolk Street, Manchester.

FOUNDRY FOR SALE. Mobbs & Company, Limited, Lion Foundry, Northampton. Owing to the continued ill-health of the managing director, who holds over 98 per cent. of the shares and who wishes to retire, this Company has gone into voluntary liquidation, and any offers to purchase the business as a going concern should be made forthwith to the Liquidator, H. FELDON BAKER, Chartered Accountant, Castilian Chambers, Castilian Street, Northampton.

PATENTS AND TRADE MARKS.

THE Proprietors of British Patent No. 224941 are prepared to sell the Patent or to license British manufacturers to work thereunder. It relates to the manufacture of wrought iron.—Address, BOULT, WADE & TENNANT, 112, Hatton Garden, London, E.C.1.

PATENTS AND TRADE MARKS—*Continued.*

THE Proprietors of the Patent No. 226751 for Improvements in or relating to Processes for Incorporating Manganese with Iron are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting same and ensuring its full development and practical working in this country. All communications should be addressed in first instance to HASELTINE, LAKE & Co., Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

5-TON GEARED FOUNDRY LADLE.—Photograph, details, and price on application. For sale cheap.—Write, Box 262, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SMALL Tilghman Sandblasting Plant, complete with cabinet, compressor, fan and receiver, £60.—Box 254, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOR SALE.—Secondhand "Osborn" Jar Ram Rollover Moulding Machine, in good working condition.—Replying to Box 264, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FRICTION CLUTCH.—One 24-in. 4-arm Modern Type by Wigglesworth, to transmit 80 h.p, with belt pulley 48 in. by 12 in. Very little used. Also one, by Haywood & Bridges, for 25 h.p. Both for sale cheap.—Write, Box 258, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUR-THROW RYDER FORGING HAMMER, centre to centre of blocks about 6½ in., blocks 2½ in. square.

B.S.A. Centreless GRINDING MACHINES, for work about 1¼ in. dia. by 6 in. long.

No. 14 NATCO MULTIPLE SPINDLE DRILLING MACHINE, arranged for 22 spindles.

12¼-in. centres S.S.S. LATHE, on 15-ft. gap bed, by LANG, variable speed head.

STONE BREAKERS, 10 in. x 6 in. to 30 in. x 18 in. size, by Hadfields, Marsdens, Thomas & Foster, Goodwin Barsby.

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